

THE ZOO AND AQUARIUM BOOK

E. G. BOULENGER



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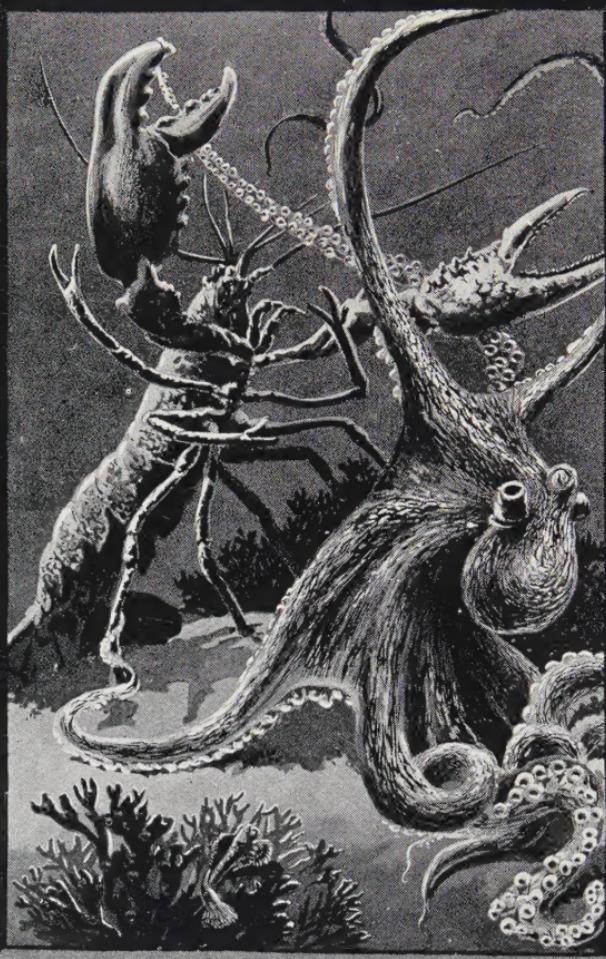
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THE ZOO AND AQUARIUM BOOK

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OCTOPUS *v.* LOBSTER.

Frontispiece.]

THE ZOO AND AQUARIUM BOOK

BY

E. G. BOULENGER

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THE AQUARIUM BOOK

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INTRODUCTION

AVAST library and not a few films have done much to make the wonders of the water-world a living reality to the stay-at-home landsman. But the up-to-date aquarium has gone further. It has made it possible to practically walk dry-shod along the river-bed or ocean-floor, and see life as it is below the surface at first hand.

Take a typical tank in the great sea-water hall at the Zoo's Aquarium in Regent's Park. Here is a big expanse of shining sand, backed by towering rocks, the whole enveloped in thousands of gallons of sea-water. Sand, rocks, and water all teem with life. From the sand peer the rolling eyes of flat-fish, buried but for their shining orbs. Here and there the waving feelers of submerged crabs, or the stubble-like clumps of worm tubes, each with a tuft of crimson plumes protruding from an opening at the top, are to be observed. The rocks are covered with anemones, flower-like creatures rivalling in form and colour the choicest blossoms of Kew. And in the all-enveloping water move the fish. Some appear almost fairy-like in their delicacy, whilst others startle one with their vivid liveries. There are fish that glide, dart, crawl,

and even climb. Fish that we at once recognize, and fish that recall heraldic monsters from some ancient tapestry. Here in the heart of London is exhibited the flaccid merchandise of the fishmonger's slab, transformed into a fairy-like deep-sea ballet,—a sight, outside of the aquarium, only enjoyed by the diver.

How is it all produced ?

* * * * *

The answer covers many hundreds of years of endeavour and experiment. Of man's first attempt to keep fish under observation we have of course no record. It probably amounted to the blocking up of some rock gully, and the retention of the fish contained therein until wanted, as is still done in different parts of the world. Originally aquatic animals were kept solely for the table, and even the great aquariums of to-day play an important part in our food supply, by acquiring knowledge which helps in framing our fishery laws.

From the old Roman times onwards the fish-pond, the great ancestor of the modern aquarium, played an important part in economic history. The Romans farmed fish, as they did most things, on the grand scale. Enormous sums were often spent on the construction of their fish-ponds, the ponds being sometimes connected by a canal to the great man's kitchen and banqueting halls. At the banquets the living fish would often be exhibited alive in aquaria. The fish-ponds, so it has been recorded, were occasionally put to more

sinister uses, inconvenient politicians and refractory slaves meeting a fearful death in a seething mass of conger-eels and lampreys. Even before the Roman period, the Chinese were ardent fish-farmers, producing "fancy" breeds which to this day delight us. All the public aquaria of the Orient, however, have, strangely enough, been introduced by Western influence. At home the fish-pond attained to a great importance in mediæval times. Every monastery, abbey, and castle possessed one, or an encircling moat which served as a protection as well as a fish preserve. Friday is not the day for fish-fare that it was, at least in England, and the demand for home-killed fresh-water fish has in consequence practically ceased. Large quantities of pike, carp, tench and perch are, however, imported alive from France and Holland for sale in the Jewish quarters of our big cities.

The relationship which animals and plants bear to each other is nowadays taught in almost every elementary school. In the old days so long as fish were kept in outdoor ponds or caged in streams the water became well stocked with plants, and the "balance of Nature" adjusted itself automatically. When, however, attempts were made to keep aquatic animals indoors in confined spaces the necessity for this "balance" became manifest. It is less than a century ago that the chemist Priestly demonstrated that the gases given off by plants were utilized by animals, and vice versa. Soon naturalists all over the world were verifying and

elaborating this apparently simple discovery, and applying its principles to aquaria, which were then chiefly of the jam-pot variety. In 1850 Philip Henry Gosse, a pioneer aquarist, felt sufficiently sure of his ground to help establish an aquarium on somewhat more ambitious lines. This was done in what is now the Wading Bird House in the London Zoological Gardens. The keeping of small aquaria soon became a cult, not only in public institutions, but in thousands of homes. Many of these early enthusiasms cooled later, but from thence onwards the general progress of aquarium-keeping was assured. Later contemporaries of the Zoo's effort were the Surrey Gardens and the Dublin Aquarium, the latter unique in that its tanks were fitted with bellows which the public were called upon to use, and thus whilst enjoying the exhibits, assisted in aerating the water containing them. London and Dublin's example was presently followed by Belfast, Edinburgh, Scarborough, Yarmouth, Boulogne, Havre, Berlin, Cologne, Hamburg, Hanover, Brussels, Vienna and Boston. Most of these aquaria were quite small. The one at Hamburg and which is still in existence, was at the time of its erection considered an aquarium "de luxe." It was designed in 1864 by Mr. William Lloyd, who later became curator of the large Crystal Palace Aquarium. Manchester and Southport followed suit, the movement culminating in 1872 in the Brighton Aquarium, the biggest institution of its kind in the world, one of its tanks

alone holding 110,000 gallons. About this time Mr. Lloyd and Professor Anton Dohrn founded the famous Aquarium at Naples. This wave of enthusiasm for aquaria, which had but a short life, created new industries,—fish and water-plant culture, aquarium construction and engineering, etc.

Most of the above-mentioned public aquaria have now vanished, and in their stead have arisen the biological stations at Plymouth, Lowestoft, Aberdeen, to mention only a few, where the harvest of our seas are investigated and safeguarded.

The old Westminster Aquarium,—its site now covered by the Central Hall,—will be remembered by many, but regretted by few. As an aquarium it was a failure from the start, and soon after its opening, sword swallowers, contortionists, two-headed nightingales and other monstrosities and music-hall turns were introduced to augment the waning attractions of the fish. Towards the close of its existence it became the “rendezvous” of a none-too-reputable public, there being more “queer fish” outside than inside the tanks.

The small Zoo and Crystal Palace aquaria were also abandoned, and from about 1890 to 1924 London was without a first-class aquarium. It was not until 1922 that it became possible for the Zoological Society to repeat its pioneer effort of 1850. Many will be acquainted with the public gallery as it now stands beneath the Mappin Terraces. Let us, however,

make a hurried survey of the entire institution, public and service. The Aquarium occupies the whole of the great semicircular space beneath the terraces. It took nearly two years to design and build, and cost about £55,000. The entrance at the east end leads into a large vestibule with a fish-pool and rockery. The turnstile leads directly into the public corridor, which consists of three halls devoted to fresh-water, marine, and tropical fresh-water exhibits. As the bulk of this volume surveys aquatic life as mirrored in the Zoo tanks we need not dwell longer in the public gallery. Before leaving it, however, it is worth pointing out that unlike in the case of many large aquaria where the illumination of the tanks is marred by allowing diffused light to penetrate into the public corridor, at the Zoo the visitors are in almost complete darkness and the tanks set in deep bays are lighted from above from an invisible source. As a result a series of brightly illuminated pictures of the underwater-world is obtained. There are in all about 100 tanks varying in size from one to thirty feet in length, the largest having a 5,000-gallon capacity. A staircase on the right of the vestibule leads to the research laboratory and the service gallery. The latter is a wide stone corridor on a level with the top of the tanks. Many aquaria have no service corridor, the tanks being spanned by planking, an unsatisfactory arrangement which has resulted in more than one keeper astonishing the public by suddenly appearing amongst the exhibits. The tanks are

constructed of slate or concrete, and the glass—in some cases an inch and a quarter thick—is held in position with mastic and a layer of thin rubber which allows for a certain amount of expansion.

Visitors are usually impressed by the clarity of the water. This is, of course, vital to the successful exhibition of aquatic life, and is the result of considerable care. The sea-water was originally brought in the ballast tanks of steamers from the Bay of Biscay. At the docks it was transferred to drinking barges, and carried to the Zoo via the Regent's Canal. On arrival it was pumped through a 650-foot-long hose directly into the enormous reservoirs beneath the Aquarium. The water is kept in constant circulation and should not need entirely replenishing for many years. It is pumped from an underground reservoir which has in the case of the sea-water a 120,000-gallon capacity, in the case of the fresh-water a 60,000-gallon capacity, to other smaller reservoirs situated in the peaks of the Mappin Terrace mountains. From these high storage tanks, the water falls by gravity into the show tanks, the overflow passing through a series of sand filters before returning underground. Oxygenation of the water is chiefly obtained by discharging the water into the exhibition tanks with great force through a pipe with a very small aperture, the resulting air bubbles being very small and producing the effect of a smoke cloud. The aquaria are also aerated by passing compressed air directly into them. Not only is the

water cleansed by being passed through the filters, but the tanks themselves are kept scrupulously clean. At the Zoo most of them are carpeted with sand on which dead animals, decaying vegetable matter, rejected food, and excrement are easily detected and immediately removed. The purity of the sea-water is further ensured by a discrete choice of the metals used in the

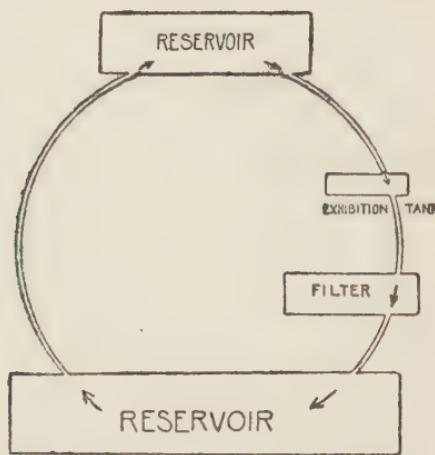


DIAGRAM ILLUSTRATING SYSTEM OF WATER CIRCULATION.

piping and the building of the tanks, as if certain kinds, such as copper and zinc, came into contact with the sea-water the exhibits would be speedily poisoned. Thus in the marine section the iron drainage pipes are all lined with enamel, whilst other piping is made of chemically pure lead.

A variety of nets is employed to remove the fish from their tanks, although many are so tame that they can be caught up by hand.

Decaying matter is removed by means of a suction pipe lashed to a pole, the easier to manipulate it. The sides of the glass inside the tanks may become coated with algæ, and this is cleaned off with a rubber mounted on a broom handle, a board being placed across the tanks to act as a fulcrum.

Although the food of aquarium fish and the methods of feeding will be dealt with in the subsequent chapters, a word on the general methods employed at the Zoo may not be out of place here and welcomed by the amateur aquarist. Horses' heart figures largely on the menu. Finely shredded, this makes an admirable substitute for fish or worms and is often accepted by creatures believed to be confirmed vegetarians. Sand-hoppers and shrimps are also used, some of the latter being "grown" on the premises. Many shrimps escape from time to time down the overflows of the show tanks through the pipes leading to the filters, where, immune from foes, they have established an ever-increasing colony. The fresh-water flea, *Daphnia*, is welcomed by many fish, this tiny crustacean being bred in large quantities in the alligator and crocodile tanks in the reptile house. They are indeed farmed by certain dealers and can be purchased in any quantities.

Vegetable feeders, such as carp and tench, will never starve provided their tank is kept well stocked with plants. For small fresh-water fish, apart from *Daphnia*, small earth worms, the red larvæ of the midge *Chironomus*, which are commonly known as

"bloodworms," the fresh-water shrimps *Gammarus*, and the white thread-like worms *Enchytrae* are the best foods. Except when quite fresh, ants' eggs with which goldfish are so often provided are quite valueless. Live food has the great advantage over all artificial fish food since if not eaten at once it need not be removed, as it will thrive and be consumed on some future occasion.

The way to an animal's heart is usually through its stomach. Fish are no exception to the rule, and a peep behind the scenes at the Zoo's Aquarium makes it very evident that the majority can in time be persuaded to display considerable trustfulness—at least at feeding time, when they are on the best of terms with their keepers. The Zoo carp will take bread, biscuits, and even monkey-nuts from the hands of complete strangers, whilst the appearance of a keeper with a dish of food produces a joyful riot in most of the tanks. At the Regent's Park Aquarium the fish will not only feed from the hand, but in some cases even allow themselves to be taken out of the water. A six-foot-long conger having been fed never raises the slightest objection when he is lifted bodily from his native element, whilst cod, small skate, gurnard and a host of other fish will practically nestle in the outstretched palm. The crawfish clamber from their tanks in a body at the sight of food, and take their daily ration from their keeper's fingers.

At the Brighton Aquarium feeding time is always

heralded by a blast from a whistle which has the effect of inspiring many of the fish with a veritable hysteria, and gives rise to some interesting questions as to the powers of hearing enjoyed by certain aquatic animals. The capture and transport of aquarium exhibits, especially the marine ones, presents many difficulties, of which the aeration of the water supply *en route* is the chief. On the journey a constant supply of air liberated from a compressor has to be introduced into the wooden or enamel travelling tanks—some of which, when full, weigh eight hundredweight, in order to keep the water fresh and the animals in sufficiently good condition to survive after their journey. Sometimes, from a mistaken idea of economizing space, specimens are herded together with disastrous results. Fish should be transported in carriers which are broad rather than deep, and the number per carrier should be low. Fifty gallons of water, if kept aerated, will support on a six-hour journey about 100 normally hardy fish of about 3 inches in length, or twenty-five fish 6 inches in length, and only three fish 1 foot in length. On arrival at their destination the fish should not be immediately transferred to the exhibition tanks, but the water in the carriers should be slowly substituted for that of the aquarium, which is bound to be of a slightly different nature and temperature. On the journey the association of unsuitable tank-mates should be avoided. As an example, a quantity of wrasse and rare crabs were recently dispatched to the Zoo Aquar-

ium from the coast. The travelling tank on arrival was found to contain only wrasse, the consignee being ignorant of the fact that of all delicacies crabs were those most appreciated by these fish.

The even temperature of the water is another essential. Except in the case of tropical and sub-tropical exhibits the average winter temperature should vary between 45° and 55°, whilst in summer it should not exceed 65°.

I will conclude this chapter with some more remarks of a practical nature which will, I trust, be of use to those whose ambitions have been aroused by a visit to the Zoo's Aquarium. If the novice will from the start, as far as possible, "follow nature," he will avoid the many pitfalls which usually lie in wait for the hasty or careless beginner. The choice of an aquarium is all important. The goldfish bowl, which is sold in thousands, is obviously the worst possible receptacle for any creature intended to enjoy life, since it violates every canon of Nature's aquaria—the rivers, lakes, and seas. An aquarium should present the greatest possible surface of water to the air in proportion to its size and depth. The rivers and seas are further lit only from above. This is ideal from the inhabitants' point of view, although not from the human observer's, who will wish to enjoy a diver's view of his aquarium,—to see it in elevation, rather than as a ground plan. This means that if the aquarium is rectangular in form, one side, and one side only should be of clear glass.

If the aquarium is of the bell-jar type, at least two-thirds of the glass should be screened with some opaque material. Nearly all the fish diseases and other troubles which exasperate the aquarist are caused, if not by sudden changes of temperature, by too much light.

Before introducing the water the aquarium should be carpeted with several inches of well-washed river sand. No other substance is so suitable, since the sand will not readily cloud the water or conceal waste products. Dead fish, decaying vegetable matter, excreta, etc., are at once visible and may be readily removed. In filling the aquarium disturbance of the sand may be avoided by pouring the water slowly into a jar stood in the middle of the tank, and made to enter slowly through a narrow-gauge siphon, the end of which is drawn out to a fine point, or controlled by a small tap.

Even in the present age of aquarium keeping there is a wide-spread belief that the water in the tank requires constant changing if it is to keep fresh. The water certainly must be kept pure, but no such violent methods of ensuring its purity should be employed. For most small fresh-water fish an aquarium well but not overstocked with plants and animals taken from still water, such as a pond, should not require further oxygenizing than that supplied by the plants. Artificial aeration may, however, be employed with advantage and is, of course, absolutely indispensable where animals taken from running water or the sea are concerned. It may be effected by liberating air into the

tank from a drum in which it has been compressed.

Whilst following nature as closely as possible it should be borne in mind when stocking the aquarium that however large the tank may be, it is after all a very small affair compared to even a pond or ditch, and that discretion must be used in the choice of "tank-mates." Scenes of carnage may be unavoidable in the wild, but are undesirable in the home. If "regrettable incidents" are to be avoided harmless vegetarians such as small carp or tench must on no account be placed in the same aquarium with aggressive carnivorous feeders such as pike or perch. In stocking the tank it is at first better to have too few, rather than too many exhibits. Additions can always be made from time to time until a perfect balance is struck, without over-taxing the tank's capacity. In fresh-water aquaria plants should be introduced, especially when the water is not circulated. Water Weed, *Anacharis*, Water Starwort, *Callitricha*, Swamp Plant, *Ludwigia*, Willowmoss, *Fontinalis*, Water Milfoil, *Myriophyllum*, are suitable plants obtainable in many ponds or ditches. The most valuable oxygenizer of all, however, is *Vallisneria spiralis*, which can be acquired from most aquarium dealers. The plants should be placed in position before the water is introduced, and their roots should be washed and embedded in the sand, or kept in position by little "sinkers" made of lead. Deep-rooting plants, such as the many kinds of miniature water-lily, should be installed in separate flower-pots.

An excess of light will not only cause the plants to become rank and sickly, but will also call to life the floating spores of undesirable algæ, which may cause the water to become opaque, and milky. It may also coat the glass with a green film, which if neglected will soon shut out the animals from their owner's view. The floating algæ may be checked by shading the aquarium for some time, whilst those coating the glass can be removed with a piece of wash-leather, shagreen, or rubber attached to the end of a stick. Better still, they can be kept within bounds by means of introducing water snails into the aquarium. Not only are they invaluable as "window cleaners," but their eggs often provide the fish with a much-appreciated change of diet.

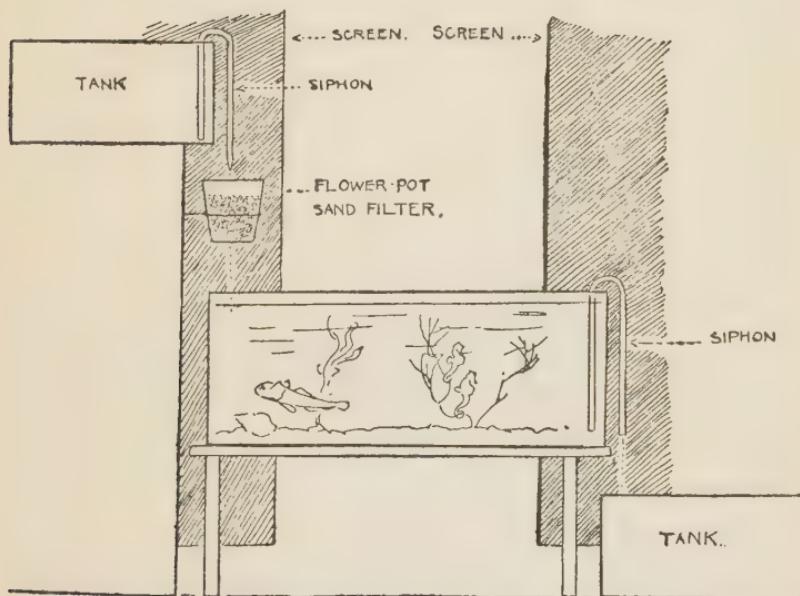
Of all the ills that fish are heir to, fungus, *Saprolegnia*, a bacterial disease, is the most widely disseminated. It shows itself in the form of a whitish or greyish film or furr which coats the outside of the fish, and which unless treated at the outset will attack the gills and cause its victim to die of asphyxiation.

The uninformed sometimes regard the presence of "fungus" in its initial stages as merely a sign of age, especially when noticed upon large carp, but it is undoubtedly a most virulent and highly infectious disease usually developed in aquaria by fish that have contracted a chill as a result of sudden changes in the water's temperature. It is often introduced through some newly acquired specimen, for which reason it is as

well to isolate all new additions to the aquarium for a short period, watching carefully for any signs of latent ill-health. If the "fungus" has firmly established itself upon a fish before it is detected, there is no hope of its recovery, and it should at once be removed,—and destroyed. Less serious cases may be checked in time by removing the fish to another comparatively dark vessel in water rendered brackish by the addition of common rock salt—a tablespoonful of salt to two gallons of water. Bathing the fish in weak solutions of permanganate of potash, copper sulphate, and ammonia, are other methods recommended, but the salt-water treatment is the safest and in my experience the most effective. A pinch of salt placed from time to time in the aquarium itself will do no harm, and will act as a check to any bacteria that may be present in the water.

The guiding principles to be observed in keeping a small fresh-water aquarium apply equally to one containing salt-water. Most animals inhabiting the sea, however, require more oxygen than those emanating from ponds or rivers, and it is best to circulate and filter the water on the principle of the large public aquarium. This may be effected by means of the simple apparatus shown opposite. A siphon empties the water from the tank A into the exhibition tank, and at the same time a second siphon runs off the water from the exhibition tank into the receptacle B. Thus a gentle but constant stream of water is caused to flow through

the tank. A flower-pot filled with sand may be employed to filter the water before returning to the exhibition tank, the water, after passing through the sand, dripping slowly into the aquarium. When the overflow tank B is full, the water it contains is emptied into tank A, and the operation is repeated at intervals. The



MINIATURE MARINE AQUARIUM, SHOWING HOW THE WATER MAY BE CIRCULATED ON THE PRINCIPLE OF THE LARGE PUBLIC AQUARIUM.

storage tank and the overflow tank should both be of equal capacity, and the aquarist will soon find that the flow of water can be controlled to last for twelve or more hours, according to the requirements of the inhabitants. With a little ingenuity the entire apparatus can be "camouflaged" so as in no way to detract from the beauty of the aquarium itself. In the con-

struction of the marine aquarium as little metal as possible should be made to come into contact with the water. Iron is the least harmful and can be used when coated or painted with enamel or bitumastic.

If the aquarist has any difficulty in obtaining water from the coast there is no reason why he should not "manufacture" his sea-water at home. The following formula has given satisfactory results :—

	oz.
Common salt	$45\frac{1}{2}$
Potassium chloride	$1\frac{1}{4}$
Calcium chloride	2
Magnesium chloride (dry)	$8\frac{3}{4}$
Magnesium sulphate	$11\frac{1}{2}$
Bicarbonate of soda	$\frac{1}{8}$

The above should be mixed with 10 gallons of soft water to which should be added—after mixing— $\frac{1}{5}$ oz. of potassium nitrate, 10 grains of sodium phosphate, 5 grains of chloride of iron ; and $\frac{1}{2}$ a gallon of natural sea-water.

The reason for adding a small quantity of natural sea-water to that manufactured chemically lies in the fact that sea-water contains some mysterious ingredient which up to the present has defied analysis, but which may be considered analogous to what is known as the vitamins contained in food. Its entire absence would result in the animals developing disease in a comparatively short period of time. In addition to shading the aquarium from the direct rays of the sun and protecting the surface of the water from an accumulation

of dust, care must be exercised in keeping the water at the same level, or its salinity will by evaporation become too great. To obviate this, the level of the water may, when first introduced, be marked upon the glass front of the tank, and the slightest falling below this level be remedied by the introduction of pure fresh-water. A more scientific way, however, is from time to time to test the sea-water, which should have a strength of about 1·025, with a hydrometer. Sea-weeds should be introduced with extreme caution as they tend to foul the water and poison the inhabitants.

The carnage of the river-bed pales to nothing compared with that of the sea, and great vigilance must be exercised in the selection of tank-mates. Only amiably disposed animals should be associated, and such pugnacious creatures as large crabs and lobsters must be given private apartments in separate aquaria. All food not consumed should be removed or disposed of by scavengers such as prawns and very small crabs introduced for the purpose. But here again discretion must be used, for if small prawns are placed in a tank containing large anemones, the span of life of the former will be short.

To sum up, those who are really interested in aquarium-keeping will never tire of their hobby, for the wonders which the watery world daily unfold to the patient and enthusiastic aquarist repay with compound interest the labour and trouble involved.

When fairly established an aquarium can be made

to hold the mirror up to "nature" in a way scarcely possible with any other form of zoological collection. Each tank at Regent's Park, for instance, shows a group of animals in natural surroundings. It is easier to bring a piece of a coral reef to the Zoo, the better to make a turtle look and feel at home, than it is to provide an elephant or a baboon with its native atmosphere.

To mingle with the crowd of visitors thronging the corridors of the Zoo Aquarium is to realize what a revelation it is to most people, and how varied are the ways of enjoying it. The appeal that the aquarium makes to scientists of every grade and description, to artists and fishermen, may be readily understood. A few folk, however, view the tanks and their contents from the strangest angles. An elderly, much-travelled general, a hero of the Great War, who I had the honour of conducting round the institution, saw in each fish merely the happy memory of some past meal. At each tank he would inquire—are those fish edible? If my reply was in the affirmative some minutes would be spent contemplating the inhabitants; if, however, I answered in the negative, we just passed on to the next. His enjoyment was of a purely gastronomical nature. The fact that the fish were not sea-sick was what was of supermost interest to the Llamas, the holy men of the mountains of Tibet, who during a recent visit to this country spent a whole morning in the aquarium. The visitor, however, who gave us the greatest shock was a lady who arrived late one afternoon carrying an

enormous carpet-bag. She went straight up to a keeper, and inquired at what time the fish were sold. It appears that she had been informed that all the exhibits were changed daily and sold by auction at closing time! The above examples are, however, isolated ones and the majority of visitors take an intelligent interest in what they see. The aquarium is a wonderful educational factor, and facts about our aquatic fauna which at one time were only known to a few specialists are now becoming common knowledge. The aquarium is further a means of clearing up many points of scientific as well as national importance. The feeding habits of our food-fishes, their multiplication, individual growth, diseases, and enemies are all vital matters which come within its scope.

PART I
THE SEA-WATER AQUARIUM

CHAPTER I

INVERTEBRATES

THE Invertebrates need little introduction, for they force themselves upon our notice at every turn of life. Those that are terrestrial are so abundant, invading on occasions even our homes, that to ignore them is impossible. But numerous as they are, their numbers become insignificant when compared with the uncountable legions of backboneless animals infesting the waters, both salt and fresh. They fill the seas with their freely swimming hordes, covering every rock and weed with a bewildering array of sedentary forms ; they mimic the branches of trees and shrubs of the air-breathing world, and compose great deposits of solid rock, strong enough to bear the habitations of man. They are as abundant at the frozen poles as in the tropics, and once held undisputed possession of the world at large. The more complex invertebrates of to-day form interesting links between the first beginnings of life and the dawn of the vertebrated animals whose progressive development culminated in the advent of man.

To systematically review the invertebrates, even those confined to our own waters, would demand a

vast library. In the present chapter, therefore, it is proposed merely to dwell upon those forms which by their size, remarkable habits, or economic importance, at once commend themselves to the notice of the aquarium visitor.

THE PROTOZOA.—These minute creatures constitute the very simplest forms of animal life. They swarm in all waters, and although the visitor to the aquarium will not find them labelled or figuring in the official guide, he may be confident that every tank he passes contains them, not by hundreds or even thousands, but by incalculable millions. Each individual creature consists of a single cell, provided with a little whip or "flagellum," with which it propels itself through the water. One common marine species is visible to the naked eye, and occurs in vast numbers. It is called the "night light" or *noctiluca*, and when present in great quantities contributes largely to the "phosphorescence" which sometimes illuminates the waves at night.

Many species of *Protozoa* form tiny shells composed of carbonate of lime, and present an endless variety of forms. These shells, being deposited layer upon layer, build up in the course of ages the great chalk deposits so common in many parts of the world.

The SPONGES, *Porifera*, attain to dimensions which render them conspicuous. The members of the

group differ from the Protozoa in that they have a body cavity supported by a horny or calcareous skeleton. The dead skeletons of some of the largest forms, such as the bath sponges of commerce, are often introduced with good effect as settings in the tropical tanks of large aquaria. Many of the smaller, native species can be exhibited alive, being either introduced attached to rocks and shells, or appearing voluntarily from spores floating in the water.

A sponge begins life as a tiny free-swimming animal propelling itself along by means of the numerous fine hairs which incessantly beat the water. Presently it settles down upon a rock or other solid foundation, and there builds around itself a horny rampart composed of minute spicules of mineral substance extracted from the sea-water. When many millions of young sponges are thus fortified and living *en bloc*, one can well picture to oneself the true nature of a sponge. It may be likened to a series of under-water tenements, the walls of which are pierced with innumerable holes and canals to permit the free circulation of the water, and so ensure the health of the community. The constant circulation is maintained by each individual animal lashing the water with a minute whip, and the currents thus maintained are clearly visible if the water containing a living sponge be tinted with some colouring matter.

The beautiful little yellow Flask Sponge, *Sycon compressum*, found on seaweed, and the red and orange

Bread Crumb Sponge, *Halichondria panicea*, that encrusts the rocks are the commonest native species, suitable for the aquarium. They have their practical uses in the tanks, serving as natural filters and extracting much organic matter from the water. Many molluscs and echinoderms feast upon them, and a number of creatures rely upon sponges for shelter, or as an aid to render themselves inconspicuous. The Fig Sponge, *Ficulina ficus*, has a habit of covering the shells inhabited by hermit crabs, both crab and sponge benefiting by this co-partnership, the former enjoying the "camouflage" afforded by the latter, which shares the hermit's meals with him. The quaint sponge crab, *Dromia vulgaris*, always carries a sponge, *Cliona*, upon his back, holding it in position with a pair of legs specially adapted for the purpose. The sponge in question is a harmful one as it plays great havoc in the oyster beds, perforating the shells of the molluscs and so rendering them easy preys to their many other foes. To prevent this oysters are frequently grown in frames which can be drawn up and exposed to the rain, a procedure harmless to the oyster, but fatal to the sponge.

The POLYPS, *Cœlenterata*, are animals with hollow interiors and are represented round our coasts by the Jelly-fishes, Sea-anemones, and Corals. At a first glance these varied forms may not appear to have much in common, but a closer examination reveals

their kinship, and shows them to be built in the main upon the same general principles. A single cœlenterate is termed a polyp, which consists of a sack-like body having a central stomach, and the sack is either anchored to a rock or shell, or to a fellow-polyp. The upper extremity of the body is furnished with a number of tentacles which gather food and pass it into the interior. There is no special outlet for waste matter as in the higher invertebrates, the "left over" portions of a meal being simply ejected through the mouth. These animals multiply by one of three methods. They may "bud off" from each other in the manner of bulbs ; they may lay eggs ; or they may increase by the method known as the "alternation of generations," which briefly amounts to this. A single polyp gives rise by the process of budding to a branching colony of polyps. In due season certain of the buds detach themselves and lay eggs, which hatch out into free-swimming larvæ. These in their turn settle down, develop into polyps and by budding off, once more create a colony. Nature's recurring decimal !

JELLY-FISHES are very delicate creatures, and rarely figure in the aquarium for long. Usually the animal is supported by an umbrella-shaped disc which by contracting and expanding propels it through the water. Sometimes, however, the disc may take the form of a boat with an inflated cockscomb which serves the double purpose of a buoy, and a sail to catch each passing breeze. The stinging, reproductive, and

feeding organs depend from the umbrella or float, and act as drag ropes to prevent the animals drifting too rapidly. Sometimes jelly-fishes occur in vast swarms, sufficiently dense to bar the passage of a comparatively large vessel, and may be blown ashore after a gale until they cover many acres of beach.

The largest jelly-fish found in Northern latitudes is *Rhizostoma pulmo*, which may measure several feet across the "umbrella," and weigh nearly one hundred pounds—a hundred pounds of water, for the animal is 98 per cent. fluid.

A beautiful chance visitor is the Portuguese Man-of-War, *Physalia arethusa*, a form supported by a "float," both the float and its dependent streamers being most gorgeously tinted with all the colours of the rainbow. It is very abundant in tropical and sub-tropical waters, where it is justly dreaded, having stinging powers far beyond those of any of its congeners. Human beings involved in its filaments suffer severely for many days or even weeks, whilst the sting immediately proves fatal to most fishes. In spite of its stinging powers, several kind of sea-snails and most turtles will attack and demolish this jelly-fish with impunity, the latter, however, always taking the precaution of shutting their eyes when going into action. The Man-of-War has been shown alive for a few days in the New York, Naples and Plymouth aquaria.

The beautiful ANEMONES which decorate every tidal pool are perhaps the most readily studied of all

the Cœlenterates. They are polyps on a grand scale, but although their methods of feeding and reproduction may be observed with the naked eye, it is often difficult to persuade the ordinary aquarium visitor that they are not the counterpart of terrestrial flowers. Their tentacles are often highly charged with stinging cells, as indeed are their entire bodies, and when irritated most species throw out from their graceful columns masses of stinging threads, which look like so much cotton. Like all polyps, anemones are distended with water, and when disturbed can, by expelling the water from their numerous pores, contract until they are mere blobs of jelly. Though apparently as well rooted as any flower may be, they are capable of gliding on their bases over the rocks or glass of their aquarium.

The majority anchor themselves in fairly exposed situations, but others affix themselves to stones or shells hidden several inches below the sand. Only the brightly hued tentacles of these protrude above the sea-bed, and the shrimp that attempts to flit across them is checked in his stride, and disappears from view for ever. Having been assimilated, the indigestible portions, such as the shell, are eventually vomited forth. Should the anemone suffer from indigestion, or object to some quality in the surrounding water, it may protrude the whole of its stomach, which resembles a fluted glass bulb, and by turning it inside out make a clean sweep of everything, a faculty which the dyspeptic may be inclined to envy.

Anemones are greedy creatures, a specimen only 2 inches in diameter having been observed to swallow a scallop the size of an ordinary saucer. As a consequence all communication between the lower portion of its stomach and its mouth was cut off. It, however, solved the difficulty by opening a new mouth at the base of its body. After this *tour de force* it was able to gratify its voracious appetite by taking two meals at once. Another specimen kept by an acquaintance of mine swallowed his latch-key which he had inadvertently dropped into the aquarium. Nearly a week elapsed before the attempt to digest the unsatisfactory meal was given up and the key ejected.

Several species of anemone may be recommended to the aquarist. The Beadlet or "Strawberry," *Actinia mesembryanthemum*, is one of the commonest of species, and abounds on every shore from Penzance to the Orkneys. In colour it varies from emerald and olive green to deep brown, red, or crimson and may be covered with golden spots, when it resembles a strawberry.

The Plumose Anemone, *Actinoloba dianthus*, is a tall graceful form having many hundreds of finely cut tentacles, so closely packed that they recall a finely curled ostrich feather. The colour varieties of the Dahlia, *Tealia crassicornis*, one of the most beautiful of all anemones found in European waters, would outrun the longest florist's catalogue. It grows to a length of 7 inches across the tentacles, such specimens



THE ANEMONE TANK.

Anemones :—Plumose, Dahlia, Opelet, Strawberry and Parasitic on Hermit Crab's shell. Feathery Tube-worm in foreground. Sea-Fan Coral in background.

Facing p. 40.]

having a column 4 inches in height. The stem is rough and warty and is provided with adhesive suckers which readily adhere to scraps of shell and gravel, thus effectually concealing the animal. The anemone is, however, often situated in large numbers on a rocky site where it is rendered conspicuous, and holiday-makers in certain parts of the Mediterranean make pleasure trips in glass-bottomed vessels to such localities, and feast their eyes on the great Dahlia beds which carpet the floor of the ocean. The Dahlia has a large appetite and after a prolonged fast will devour such large creatures as shore crabs, hermit crabs in whelk shells, small fish and even fellow-anemones.

Few CORALS thrive in an aquarium, but the hard limy skeletons of some of the reef-building forms are suitable for decorating tropical tanks, and large masses are shown at the Zoo Aquarium where they form a picturesque and fitting background to such creatures as turtles and coral fishes. They are the nearest that most of us will ever get to the glories of the barrier reef. In life these huge white tree-like structures are clothed in dazzling tints of orange, pink, green and gold as each small polyp thrusts himself half out of his stony castle.

Our native Sea Fan, *Gorgonia verrucosa*, is a shrub-like form of soft coral of a brilliant pink or orange tint and grows to a considerable size. The polyps are built up on a black horny core or axis, which when denuded of the animals and washed ashore is often

mistaken for a dead bush. It thrives for some months in the aquarium.

The Dead Man's Fingers, *Alcyonium digitalum*, is a flexible coral, very abundant around our shores where it is to be found attached to stones and shells. When alive it is cylindrical in form, making large clumps of pinkish "fingers" from which protrude innumerable transparent polyps. When dead the fingers become flabby and grey in colour,—hence its gruesome popular name.

ECHINODERMS are divided into three groups, sharply contrasted as to their outward shape, yet all mere variations of the same general theme. They comprise the Starfishes, the Sea Urchins, and the Sea Cucumbers, and, as their scientific name implies, they are all animals with spiny skins. They are, without exception, marine, for the reason that fresh-water does not contain sufficient mineral matter for the construction of their tough calcareous coats. Echinoderms come of an ancient lineage, for they had their beginnings when the world was young, and in those far-distant days they sometimes attained gigantic proportions. Over this country there once rolled a vast ocean in whose depths dwelt enormous starfishes having a spread of "finger" that would outspan the largest round table ever constructed. To-day the degenerate descendants of this mighty race swarm upon the sands and fill every convenient rock-cranny with a multitude

of fantastic shapes, yet all built upon the same fundamental principles. Let us take as an example a typical starfish. It is an animal having the body usually divided into five rays or arms, which are built up on a siliceous or limy framework. In some Echinoderms the various portions of the frame may coalesce so that they form one continuous structure of jointed armour plating, but in others such as the common starfish the skeleton is covered with a leathery skin. The rays of the starfish which may be divided and subdivided and subdivided yet again, meet at a point so inconsiderable that it can scarcely be called a body. As a result various organs of the animal are portioned out in equal sections, and accommodated in the arms. The creature is the possessor of a central mouth, a separate opening for the ejection of waste matter, a comparatively well-formed intestine, and a fairly efficient nervous system. They are of nomadic temperament, and are able to indulge their taste for a wandering life by being fitted with a wonderful apparatus termed the "water vascular system." By means of this system they are propelled by hydraulic power. Watch a starfish that happens to be "spreadeagled" on the glass front of an aquarium, and it will be observed that the under-surface of the animal is set with hundreds of small and semi-transparent tubes, each of which is provided at its tip with a little circular sucking-disc. A number of these tubular feet take a firm hold of the glass, and drag the creature forward.

The "feet" in the rank immediately behind do likewise, and they in their turn are followed by yet another series—and so the starfish progresses with an insidious gliding movement, wonderful to behold. The inner workings of this at first sight complex apparatus are in reality beautifully simple. The central mouth is surrounded by a circular tube from which radiate other tubes penetrating the arms to their tips, and they are connected to yet another series made of hard, limy substance, and called the "stone canal" which is in its turn connected to a series of hairs. These hairs by continual vibration fill first the stone canal, and then the flexible water pipes controlling the suckers or tube feet. As the water is forced into them they become stiff and inflated, shooting out in whatever direction the animal desires, and mechanically attaching themselves to whatever they may encounter. Having taken a firm hold the water is shut off from them, and other tubes become inflated in their turn. So the starfish goes marching on. When he tires and progression is no longer desired the engines or vibratory hairs are simply closed down, and the animal comes to rest.

Like many invertebrates, and a few vertebrates, starfishes have the power of regenerating lost parts. Thus if a single arm be torn from a starfish, it will grow one or more arms to bring itself up to full strength. This power of reproducing lost limbs at one time gave rise to a ludicrous and even disastrous state of affairs on the oyster beds. The oyster fishermen dredged up,

—as they still do—enormous quantities of starfish. Now the starfish being the oyster's worst foe, what must the men do therefore, but tear the hated creatures into pieces and fling them back into the sea where they speedily repaired themselves, each piece becoming in time a perfect starfish ready to play a return match with their persecutors. Millions of starfish were thus dealt with and as a result thousands of pounds lost



THE STARFISH.

to the oyster-farmers. The men know better nowadays, the starfish being taken ashore and placed by the cartload on the land where they make a splendid fertilizer.

Starfish will eat almost any kind of flesh, clearing the bait from the lines and even invading lobster pots. They are specially fond of shellfish, which they clasp in their arms. To open an oyster or a scallop the

many hundreds of suckers tug and strain as one, the total pull exerted having been calculated at as much as 11 lb.

Although of little nutritive value the starfish is eaten by a number of large fish. As he is also infested with numerous parasitic worms and molluscs he does not have things entirely his own way.

Starfishes begin life within a minute transparent egg, and are tiny free-swimming larvæ when they hatch out. They then resemble little glass balls which ferry themselves through the water by means of innumerable lashing hairs.

Two species of British starfish may be kept for some months at a time in the aquarium. They are the Common Starfish, *Asterias rubens*, which lives in both deep and shallow water, and is so frequently stranded by the tide, and the Burrowing Starfish, *Astropecten irregularis*, which frequents chiefly shallow water where it does much damage in the oyster beds, and may be differentiated by the spines which clothe its surface which are so tightly packed as to form an almost velvety cuticle. Like the common form it is very active, and if turned upon its back will quickly right itself by arching its rays, and throwing a somersault. Although quite abundant on the south coast it is less in evidence than *Asterias* owing to its habit of burrowing in the sand.

The largest species of Starfish, *Luidia sarsi*, which may measure $2\frac{1}{2}$ feet across the arms, can unfortunately

not be obtained for aquaria as it is so brittle that it immediately breaks into pieces on being touched.

One or two of the true Brittle Stars, however, in which the slender rays are set with innumerable spines, can be kept in captivity for short periods. They are remarkable in gliding spider-like over the sea-bed and parting with their limbs upon the slightest provocation.

The Sand Stars are similar in design, but have the arms encased in smooth armour, quite devoid of spines. In a very lovely form known as the Rosey Feather Star, *Antedon bifida*, each of its ten arms is beset with delicate plume-like branches that remind one of ostrich feathers dyed a vivid rose colour. Most animals tend to "throw back" or at least to recall their early ancestors during the first stages in their development. This is noticeably the case with the Feather Star which begins life as a free-swimming larva. Presently it becomes fixed and grows upon a stalk anchored to a rock in the manner of its forbears—the crinoids, now almost extinct, but which at one time had a world-wide distribution and attained to a great size. In time the Feather Star breaks away from the stalk and once more becomes a rover, in which capacity it spends the remainder of its life.

The Sea Urchins may not at first sight appear to have much in common with Starfishes. Imagine, however, a starfish in which the five arms have been turned backwards until their tips meet, and the points and edges united with the tube feet pointing outwards.

Thus a sea urchin is produced. Like starfishes, sea urchins are active and voracious creatures, some burrowing in the sand, others climbing rocks or patrolling gravel reaches. The only species that survives for any length of time in aquaria is the little Purple-tipped Urchin, *Echinus miliaris*, a pretty creature the shape and size of a tangerine, and protected by a dense covering of dark green spines with delicate lilac points. Although similar to the starfishes in most of their ways, this and many other sea urchins have undergone some curious modifications in structure, necessitated by their globular shape. Each spine is set in a ball and socket joint, so that they "give" when the tube feet are employed in climbing rocks, or the glass front of a tank, and serve to maintain the creature's equilibrium. The mouth in most sea urchins as in all starfishes is central, although in the sand-burrowing Heart Urchin, *Echinocardium cordatum*, which has soft, yellow, silky spines, it is situated on one side. A typical urchin's mouth is a most complex structure, consisting of many portions and possessing five strong chisel-like teeth which are employed for cutting up its food. This remarkable appliance attracted the attention of Aristotle, the father of natural history, and is to this day commonly referred to as "Aristotle's Lantern."

The Edible Urchin or Sea Egg, *Echinus esculentus*, is a common British species. Although seldom used for food in this country it is in great demand in certain parts of the continent where, having been denuded

of its spines, it is cut open and eaten with a spoon.

The Sea Cucumbers, so called from their shape, are built on the same pentagonal plan as are the starfish and sea urchins, but are fashioned for a less obtrusive life, being of decidedly furtive habits. Burrowing deeply in the sand or mud, or squeezing into the fissures of rocks, as is their custom, they would be impeded by the possession of so unyielding an armour as that of the sea urchin, whilst the stiff-jointed cuticle of the starfish would be almost equally unsuitable. Sea cucumbers are therefore lax and fleshy and capable of great expansion and compression. One species, the Trepany or Bêche-de-Mer of the tropical seas, is made the object of an important fishery, and off the great Barrier Reefs are collected in their thousands by the natives, who, after having taken them ashore, clean, dry, boil and finally smoke them. They are served in a number of Chinese restaurants in London, but are not found palatable as a rule by Europeans, on first acquaintance, the taste for them being a decidedly cultivated one. It is, however, an extraordinary important fishery, meaning much to the Orientals, and is fraught with as much danger and romance as attends the gathering of pearls.

The tube feet of the sea cucumber are arranged in five irregular rows along the body which may vary in length from 2 inches to 3 feet according to the species.

The Sea Gherkin, *Cucumaria saxicola*, is an elegant little creature with usually a milk-white body and

purple tentacles, specimens from shallow water being darker in colour. It is very abundant off our coasts and will live for many months in a quite small aquarium.

The Cotton Spinner, *Holothuria nigra*, is the giant of its race,—in British waters, often exceeding a foot

in length, and having a girth of at least 9 inches. It is deep brown above, sulphur yellow below. Its method of defence is noteworthy, for the creature upon being molested will eject a vast quantity of sticky threads, which immediately swell on exposure to the outer water and form an entanglement from which a fish or crab seldom escapes.



COTTON SPINNER.

WORMS.—“Worm” suggests something unpleasant—a creature not to be touched with the naked hand, and as

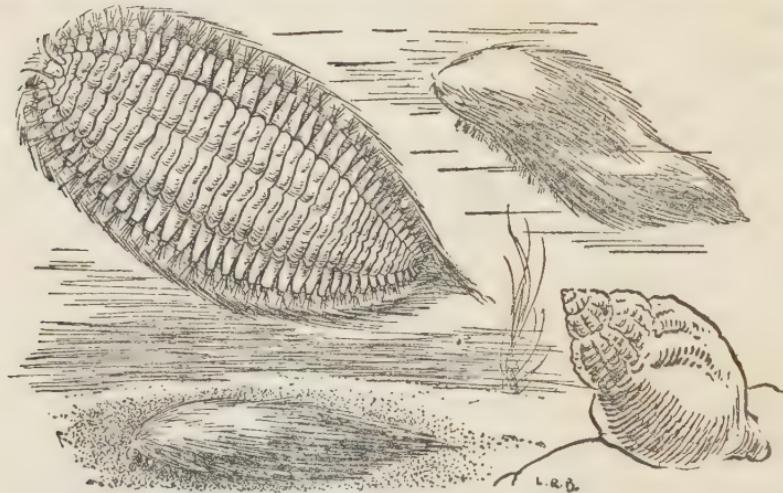
a term of disparagement has no equal. This is hard on the land worm, for he does much good by turning up the soil and cleansing it of many impurities. But his outward appearance is against him, and this, combined with the fact that he shuns the light of day and does his good work unostentatiously underground,

is sufficient to condemn him in the eyes of the majority of people. In the aquarium, however, we meet creatures which invest the word "worm" with an altogether new significance. Some swim like fish, shine with silvery scales and are clothed with coats of prismatic hairs, rivalling in colour the gayest butterflies and birds. Others coyly hide their personal charms in graceful tubes of sand, gravel or scraps of brightly tinted shells. Many are of a retiring disposition and hard to find, but quite a number of tube-builders congregate in such quantities that their high-piled tene-ments form reefs and little islets in the sea. Frequently these creatures have spoilt a vessel's speed record by so clogging her keel with their lime-built fortresses that she has had to be docked on returning home from her voyage. The sea is full of fantastic and fascinating creatures which although they disguise their true natures, scientifically speaking, answer to the name of "worm."

Worms are abundant in every sea, and our own shores provide many hundreds of species. Unfortunately they seldom accommodate themselves to the confined area of an aquarium. A few very showy examples may be kept alive for comparatively lengthy periods, and to such we invite the reader's attention.

A very striking worm is known as the Sea Mouse, *Aphrodite aculeata*, which is about 7 inches long by $2\frac{1}{2}$ across, and is quite the bulkiest member of the order to which it belongs. It is one of the *Polychæta*,

or "many-footed" worms, the body being divided into forty-three segments, each provided with a pair of feet surrounded by bristles. It is the possessor of a definite head with a brain, eyes, antennæ, and a mobile proboscis or snout which can be extended some distance for the purpose of seizing food. The whole



SEA MOUSE.

of the animal's upper surface is completely covered with a dense coat of greyish hairs, the long hairs fringing the sides displaying an amazing series of iridescent colours, dazzling in their brilliance; whilst the hairy coat serves to collect sand and thus renders the sea mouse inconspicuous, many fish rout him out of the sand and devour him greedily.

The common Rag Worm, *Nereis diversicolor*, a graceful creature gleaming with rainbow tints, is familiar to all who have done any sea-fishing.

It burrows in the sand or mud, and when extracted for the purpose of bait does not hesitate to use its powerful jaws upon the fingers of its captor. As with many polychæte worms its methods of reproduction are very peculiar. The hinder portion of its body develops a large number of eggs, and this breaking off from the main portion, develops a head and becomes a separate individual. This extraordinary procedure has a number of strange variations amongst different kinds of worms, in some cases the egg-bearing portion developing a head before separation.

The Hermit Crab Worm, *Nereis fuscata*, is specially remarkable in always being found in conjunction with a hermit crab, which tenants the empty shells of whelks and winkles. The worm lives in the spire of the shell, and relies for sustenance upon sharing such food as the crab happens to find. As the latter believes in good food and plenty of it, it does itself well. The life of the worm is indeed an easy one, for resting in the upper portion of the shell it only becomes active when there are unmistakable signs of a meal being served, when the lodger bestirs itself and comes down to dinner. It is a curious friendship, for the hermit lives at enmity with most creatures, and yet never seems to resent the presence of the worm, or to offer it the slightest opposition even at feeding time. The worm, which grows to a length of 6 inches, is of a deep terra-cotta colour with vivid white lines running throughout its entire length.

The worms which may be relied upon to make the finest exhibition in the aquarium are those known as "tube-builders."

The Peacock Worm, *Sabella pavonina*, is a typical example, and its cylindrical homes may be seen sticking out of the sand in very large numbers, the foot-long tubes projecting several inches, when the sandy area inhabited by these creatures resembles a field of stubble. When, however, the worms inhabiting the tubes are "in action" the stubble field becomes transformed into a miniature palm-grove, for each worm is provided with a large coloured, fan-shaped crown of gill-plumes, which serve not only to gather food, but also to play an important part in the building of the tube. The plumes gather portions of the surrounding sand or mud, and pass them on to the mouth, which places them layer upon layer on the upper edge of the tube, much in the manner that a bricklayer might build a round tower. Some of these tube-builders use coarse material such as shell gravel, and in aquaria they may be supplied with coloured beads, the resultant tube having a distinctly striking appearance. These worms are extremely cautious, and retire into their fortresses upon the slightest cause for alarm, such as a shadow falling across them. Many close the tube with a sort of trap-door, or a series of valves, which effectually prevent the ingress of any chance caller. They are further provided with a series of stiff bristles and hooks which render it impossible to drag them from their castle.

Spirorbis borealis of our coast makes a small flat coiled tube about $\frac{1}{8}$ of an inch in diameter formed of small pieces of rocks and shells, and the larger sea-weeds are often densely studded with this worm. Apart from being extremely active, it is less subject to "nerves" than some of its relatives, so that its plumes and other features are more easily studied.

An impressive tube-builder, and one that thrives specially well in the aquarium, is the large Feathery Sea-Worm, *Spirographis spalanzoni*, which inhabits the Bay of Biscay and the Mediterranean. The large feathery plumes, which are coloured orange with chestnut-brown markings, wave about at the end of a long slender stalk and remind one more of chrysanthemums than worms.

A ribbon worm, *Lineus longissimus*, popularly known as the Bootlace Worm, is occasionally kept for short periods in aquaria. When quiescent it resembles nothing so much as a mass of liver, but when active may extend itself to a length of 90 feet. Its habit is to lie concealed beneath an overhanging rock, and upon the approach of a fish to shoot forth a sucker-like mouth which seizes upon the unsuspecting prey. The fish naturally makes desperate efforts to escape, but it is being "played" with a living fishing-line which follows all its movements without losing grip, until finally the exhausted creature is overpowered and engulfed. The creature is very brittle and readily breaks up into innumerable fragments, all of which are capable of

growing new heads and tails, and ultimately becoming a fully-grown worm.

The CRUSTACEA contribute to man's food supply either directly, as in the case of the crab and lobster, or indirectly by constituting an important item in the diet of our food-fishes. They are omnipresent, and it may be safely asserted that for each showy specimen that attracts the visitor's attention in the aquarium, there are countless hosts of minute forms sharing the same tank which are invisible to the naked eye, save when they are present in such numbers as to actually discolour the water.

Whilst at times bearing superficial resemblances to their relatives the insects, the spiders and the scorpions, the crustaceans present many characteristics which make them at once distinguishable. Primarily there is the shell or crust which gives the order its name. This shell usually envelops the animal from head to tail, but is thinned out in places, so as to be almost membranous, thus forming the joints which permit of free movement. It is quite hard and unyielding, and must be changed from time to time in order to permit the animal within to increase in bulk. Many crustaceans when first hatched are quite unlike the adult form and pass through some startling changes before arriving at maturity. Some, however, like the lobster and sand-hopper, are almost miniature replicas of their parents as soon as they hatch from the egg. Another

typical feature is the body, for it is divided into a number of segments, each bearing a pair of limbs or "appendages" which are not uniform in size or shape like those of a centipede, but are situated on different portions of the body and are modified to serve a variety of purposes. These appendages may be drawn out into long filaments and employed as probes or organs of touch, serrated to do the work of teeth, flattened to perform the office of shovels or paddles, strongly hooked and used as climbing irons, or so constructed as to form formidable forceps and tweezers. In the aquarium crustaceans make the most fascinating exhibits, as they attract attention not only by their strange forms, but also by their restless energy and entertaining habits.

The Common Lobster, *Homarus vulgaris*, has usually a blue-black armour, deep-water specimens being darker than those found in the shallows; sky blue, brown and even scarlet varieties, however, are not very uncommon. The animal is provided with a head, thorax, and tail, which are divided into a number of segments, and twenty pairs of appendages—one pair on which the eyes are mounted, two pairs forming antennæ, three pairs forming jaws, three pairs known as foot-jaws and which serve the dual purpose of breaking up the food and circulating the water in the neighbourhood of the gills, five pairs used for progression, the first of these forming the claws, and six pairs situated under the tail and known as swimmerets. The

two claws differ in size. The larger one is blunt on its inner side and is used for crushing the shells of its prey, whilst in the smaller claw the inner edges are sharp and employed for cutting purposes.

The eggs, up to 80,000 in number, are fastened to the undersurface of the tail, and are aerated by the incessant flapping of the swimmerets. The lobster is a born fighter and constantly engages in conflict with his tank companions, sometimes losing his life, or at the best several limbs. Therefore, anybody well acquainted with this crustacean in his unboiled condition must be surprised at the "drawing-room" appearance of the Zoo specimens. There are no claws or limbs missing—or none to speak of—and no feelers snapped in half. The explanation of the apparently exemplary conduct of these lobsters lies in the fact that they do their hardest fighting at night, and the "second bests" are removed to reserve tanks in the morning, where after casting their shells they speedily recuperate and grow fresh claws, antennæ, or other items lost in the course of their night out. The gaps in the lobster ranks are filled by waiting understudies, and by the time these are injured the original lot are usually in a fit condition to appear again before the public.

Damage to claws and other limbs often gives rise to curious monstrosities, a cast crushing claw, for instance, being sometimes replaced by one fashioned for cutting purposes.

When the time is ripe for the lobster to moult, the

creature loses its usually ravenous appetite, and retiring into some snug retreat awaits the great change. This is heralded by his old armour cracking at the juncture between the thorax and the abdomen. In the crab the method is quite simple, for the shell splits at the seams upon its lower surface, the upper portion lifting off like a dish-cover. The lobster, however, has a hard struggle. Bit by bit, with many pauses to rally its energies, the animal extracts every portion of his soft and pliant body from the old armour, every particle being cast, even to the eye-lenses, gills and stomach lining. The lobster comes through the ordeal weak, helpless, and with a soft body, and when in this hapless condition is often attacked, not only by his companions but by such normally pusillanimous creatures as shrimps and prawns. In the aquarium, when about to "cast," the lobsters instinctively feel helpless, and at the Zoo take shelter in holes in the rockwork which have been provided for them for that purpose. If, however, they are spotted to be in the act, no risks are taken, and they are immediately removed to the reserve tanks. Sometimes they have to be helped in the process, just as the snakes in the reptile house have at times to be assisted in shedding their "skins."

The new carapace, which is always slowly forming beneath the suit actually in use, hardens after four or five days' exposure to the water, the lobster often helping in the stiffening process by making a meal of his old clothes. Under favourable conditions the lobster

may attain to a weight of from eight to twelve pounds, and live for twenty years, such veterans usually being found encrusted with barnacles and other sedentary creatures,—a sure sign that the shell has not been cast for some considerable time. A lobster of this age and size is a very powerful creature, and has few enemies apart from the all-devouring conger, wolf-fish, and octopus.

The lobster is subject to an amusing experiment. It will be found that by stroking it in a certain direction a coma is produced, so that it remains perfectly still, when it can be made to rest tail-upwards, standing on its "beak" and outstretched claws. The coma is quite transitory, and the animal so imposed upon usually comes to more bellicose than ever.

Another popular long-tailed crustacean is the large orange or yellow Craw-Fish or Rock-Lobster, *Palinurus vulgaris*. Like most crustaceans it is hatched from an egg,—one of many thousands, carried upon the under-surface of the tail. But whereas the lobster hatches out with a strong "family likeness," the little crawfish differs so markedly from its parent that when first discovered it was assigned to a separate species. The adult crawfish is an entertaining creature, and shares the lobster's habit of burying scraps of food against a rainy day. At the Zoo these crustaceans soon learn to climb to the top of their tank, where they take food from their keeper's hand. Though lacking the lobster's massive pincers, they show great dexterity in

THE CRAWFISH TANK.



opening shell-fish. They further evince a certain amount of musical talent, for by rubbing the basal joints of their immense antennæ against the sides of their beaks, they are able to produce loud grating sounds, not unlike a beginner's effort on the double bass. Their reason for producing this noise has not been satisfactorily explained.

The antennæ, so noticeable in all the members of the lobster tribe, are more than simple organs of touch. At the base of each is a tiny cavity, containing a few grains of sand, and investigations have proved that these serve to maintain the creature's sense of balance, corresponding to the semicircular canal of the human ear. Further certain hairs fringing the antennæ, and some of the other limbs, are provided with nerves which are in immediate connection with the creature's brain. These are termed "auditory hairs," and it is believed that they serve not only to transmit messages by vibration, but to pick up sound waves in the surrounding water. If this is so, they have anticipated the latest marvel of this progressive age.

The Flat Lobster, *Scyllarus arctus*, is a strange form which is very common in the Mediterranean, where it is used for food. Its short shovel-shaped antennæ are used for defensive purposes, and for burrowing, and concealing food whilst in the act of feeding. In striking contrast to this sluggish animal is the Common Prawn, *Leander serratus*, which is so transparent that its internal economy is clearly visible through its shell,

thereby differing markedly from the Shrimp, *Crangon vulgaris*, which is richly mottled.

Crabs and lobsters sometimes journey to the Zoo aquarium packed in damp seaweed, a form of travelling which if protracted for more than twelve hours results in the crustaceans arriving in a very feeble state of health. If immediately on arrival they were placed in deep water they would drown, their bodies having become filled with air *en route*. To obviate this, as they are unpacked they are laid upon their backs in quite shallow tanks, filled with just enough water to partially cover them. In these they recline and "bubble" out the air until their gills are once more filled with the life-giving salt-water, the patients being considered "fit" when able to struggle to their feet and turn over without assistance.

The crabs, of which there are many thousands of species, all begin life as tiny shrimp-like creatures which swim freely on the surface of the water. They change their shells frequently, and pass through several stages of development before attaining the parent form. When this is reached they tuck their tails beneath them, adapting themselves for a life to be spent in rock crannies or beneath the sand.

The Common Hermit Crab, *Eupagurus bernhardus*, starts life in the usual manner, but upon taking to the sea-bed is at once faced with a housing problem. His abdominal region is practically devoid of armour, and in a world of foes demands instant protection. He



COMMON HERMIT CRAB CHANGING SHELLS.

therefore tucks himself into the empty shell of a whelk, winkle or other gastropod mollusc. If he cannot find an empty shell to his liking he ejects the original tenant, and gains a dinner and a castle simultaneously. His

whole life is spent in one long fight for food and residence. Every time he changes his armour and increases in size he is confronted with the search for a home, for the former shell is now too tight to be comfortable. Shells are not made to measure, and the hermit must sometimes examine scores, probing their housing capacities with his legs and claws before finding the "ideal home." Hermit crabs are prolific animals, and the empty shell supply is seldom in excess of the demand. Furious battles are consequently fought for the possession of a home, and even when the victor is ensconced, and the doorway blocked with his large right claw, the victory is not necessarily won, as the fight will be continued unless the ejected crab has been completely "knocked out."

A remarkable feature of these crabs is the partnership which exists between them and a large anemone, *Adamsia polypus*, the latter invariably attaching itself to a shell inhabited by a hermit crab. Although sharing the crab's food the anemone is deliberately encouraged by its host for the protection it affords. A cod, for instance, will not hesitate to engulf a large hermit crab, whelk-shell and all, but thinks better of it when the shell is ornamented with two large anemones, which are not only very unpalatable, but render themselves highly noxious by waving masses of stinging tentacles and by throwing out stinging threads. In the course of time these anemones dissolve away the shell with the result that the hermit may spend his declining days in

an expansive cloak of anemones. His housing-problem troubles are then over.

Crabs vary very much in form. Some, such as the Masked Crab, *Corystes cassivelauanus*, are built for a life spent buried in the sand, taking in the sea-water through a pair of "feelers" which unite to form a tube down which the water is carried to the gills. Others known as Swimming Crabs have the hind feet flattened into paddles with which they take graceful swallow-like "flights" through the water.

Very popular with the visitors to the Zoo aquarium are the Spider Crabs, of which the large Thorn-back Crab, *Maia squinado*, is the common type. The shell of the Thorn-back is covered with knobs, spines and bristles which make a secure anchorage for seaweeds and all kinds of growths with which the creature methodically attires itself,—a form of "camouflage" carried to a high pitch of perfection. A large crab that has lived long and worked hard may indeed be completely hidden beneath his disguise. Of course, a change of shell necessitates the cloak of weeds being planted afresh, but the industrious animal never counts the labour. If no weeds are to hand he will solemnly cover himself with pebbles. These may roll off, but "dogged does it," and with a Job-like patience the crab persists in his self-appointed task, until he is indistinguishable from his surroundings. In dealing with crustaceans it is, of course, impossible to mention all the kinds which may be successfully kept in aquaria.

British waters alone provide over fifty species of crabs. Some crustaceans are so small as to escape the attention of all save the patient observer, but a few, apart from the crabs, lobsters and prawns, obtrude themselves before our notice in a variety of ways.

The Sand-hopper, *Gammarus marinus*, for instance, so common on every beach, is exhibited in large quantities in most aquaria, as it is used as food for the fish. The little creatures, often known as sand-fleas, are not as popular as they deserve to be, owing to their habit of co-mingling with seaside picnic parties and working their way between the sandwiches and into the teapot. We may be glad, however, that they abound, for not only do they constitute the principal fattening food of the young of many of our most valuable food fishes, but they do invaluable work as scavengers. Over twenty thousand have been counted "clearing up" a dead sea-urchin no bigger than a small orange. But for such "inspectors of nuisances" the sea would soon become polluted to a dangerous extent.

Less numerous than the sand-hopper are the various fish-lice, which are allied to the wood-lice of our gardens. They may often be seen adhering to the gill-covers of such fish as wrasse and cod. The species chiefly affecting the wrasse is a large form, *Anilocra mediterranea*,—about the size of a cockchafer. These creatures which are usually found in pairs, male and female, leave their unfortunate host at night when they swim about looking for fresh fields to conquer. *Bopy-*

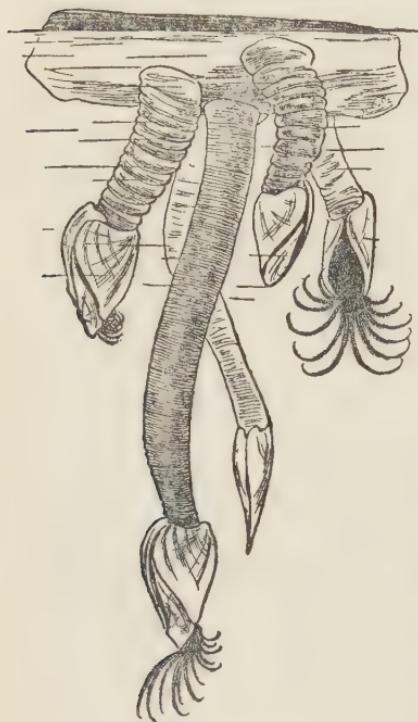
rus squillarum invades the gill-chambers of the prawn and causes an enormous enlargement of its host's carapace. A related form, *Limnoria lignorum*, has proved a serious scourge to man. In the old days, many of our large wooden ships have been rendered unseaworthy by this tiny pest, which, congregating in vast numbers, has riddled the timbers through and through until they appeared like so much sponge. To this day it causes much damage to harbour piles, dock gates, etc.

The majority of crustaceans are active creatures—here to-day and gone to-morrow. A few, however, having once sown their wild oats settle down for life, and anchor themselves permanently to any convenient shell, rock or piece of timber which may come to hand. Such are the Barnacles of which two great groups, the stalked barnacles and the acorn-barnacles, are common to our shores, and may sometimes be seen alive for short periods in public aquaria. The barnacles begin life as active, free-swimming, shrimp-like creatures, constantly changing their shells, and with each change become more and more adapted to a sedentary existence. When ready to settle down they anchor themselves by their antennæ—provided for the purpose with a kind of cement—whilst their legs which once rowed them vigorously through the sea become adapted merely to sweep the water for passing scraps of food.

The acorn-barnacles, which encrust every rock, are stony, conical-shaped buildings with an opening at

the top, guarded by a sort of folding door through which the feet are thrust at feeding time, and the scraping of millions of these minute doors may be quite distinctly heard at low tide as a sort of hissing sound.

The goose-barnacles have long been famous from



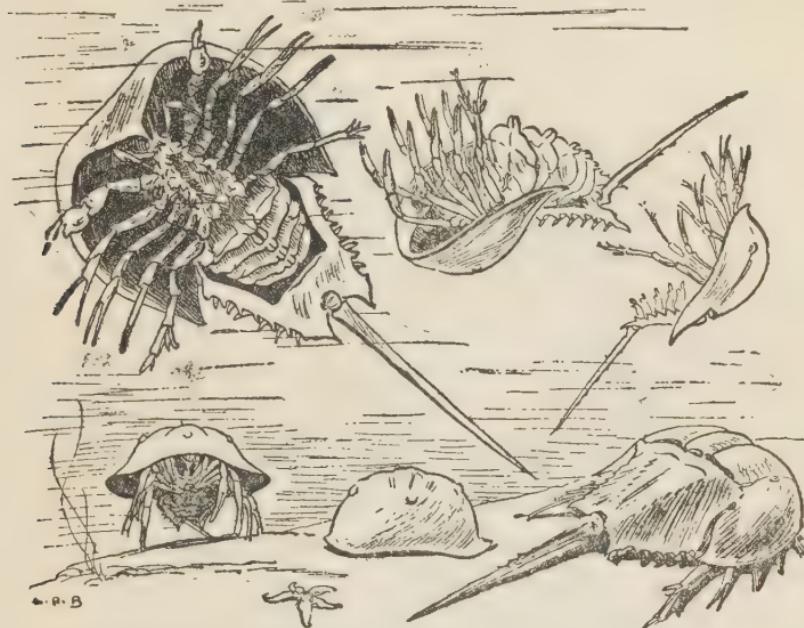
GOOSE-BARNACLES.

the old belief that they turned into geese. They anchor themselves by their antennæ much after the fashion of the acorn-barnacles, but the front portion of their heads grows to an enormous length with the shell-encased bodies at their opposite extremities. Unlike the acorn-barnacles that when adult for ever stand upon their heads on the same spot, the goose-barnacles attach themselves to floating timber from which they

hang body downwards, raking in food from the water.

A very strange degenerate relative of the barnacles is *Sacculina*, a soft oval-shaped creature which may often be observed attached to the undersurface of a shore crab. It begins life as a wanderer, as do all the

true barnacles. When, however, the time comes to settle down it sinks to the ocean-bed, discards every vestige of shell, and proceeds to affix itself to the first available crab, sucking nourishment from its host by means of long branched filaments. The crab is doomed, but before death supervenes the parasite

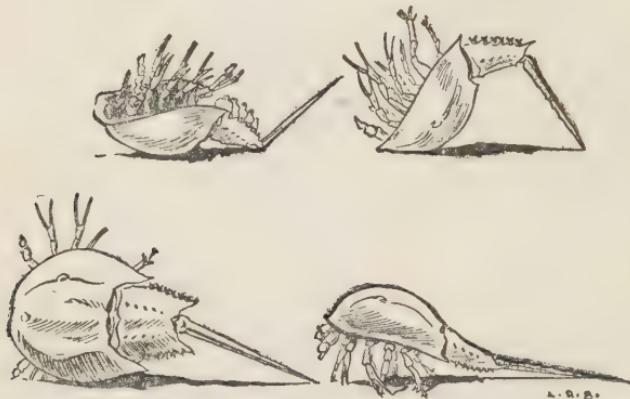


HORSE-SHOE OR KING CRAB SWIMMING AND WALKING.

sometimes effects an extraordinary change in its host's anatomy, causing the reversal of its sex.

In the Horse-shoe Crab or King Crab, *Limulus polyphemus*, which is often exhibited in public aquaria, we have not a true crab, but a creature which is a representative of a group forming a connecting link between the crustaceans and their allies the scorpions, spiders,

and centipedes. The Horse-shoe Crab is a survival from the prehistoric past, and although now confined to the tropical and sub-tropical seas, once upon a time enjoyed a world-wide range. The reason for its survival is not difficult to explain. The animal is entirely useless to man, and its body contains so little nourishment that none save a few giant saw-fish think it worth their while to attack it. The Horse-shoe Crab subsists



HORSE-SHOE OR KING CRAB REGAINING ITS FEET AFTER HAVING BEEN TURNED OVER.

upon molluscs and small crustaceans found in the sand, in which it lives half-buried for the most part.

The upper portion of the body of these "crabs" is protected by two large bony shields, the first curved backwards at an angle and bearing four eyes, the second which is armed with spines pointing obliquely backwards. The body is armed behind by a long spike-like tail which is movably articulated and of service to the animal in helping it to recover its position when it

has fallen, or been turned on its back. The gills which are situated on the undersurface are composed of numbers of plates arranged like the leaves of a book and are supported by five pairs of limbs. The antennæ and jaws resemble limbs and terminate in small pincers. The true legs are short and entirely covered by the shields.

Off the coast of certain parts of America these creatures occur in hundreds of thousands, but even the most ingenious of speculators have failed to turn them to account.

The MOLLUSCA form one of the principal divisions of the Animal Kingdom, and includes such well-known creatures as the snail, slug, whelk, oyster, and octopus. The sixty thousand living species present an amazing array of contrasted forms, some being minute, whilst others rival the largest land animals in bulk. Representatives of the group abound in all parts of the world,—on land, in the fresh-waters, and especially in the oceans. They have a well-defined heart, and complex circulatory and nervous systems. In all cases where there is a distinct head, we find a tongue which may take the form of a rasp-like ribbon or a powerful beak. A characteristic feature of many molluscs is the shell, in which the great majority of species are more or less completely enclosed. The shell is composed of carbonate of lime, and is secreted by the animal. It may be formed of one piece or of

two or even more pieces. When the animal is the possessor of a shell made of a single piece it is known as a *univalve*; when of one made of two pieces joined together by a hinge it is called a *bivalve*. In the case of the former the shell is occasionally hidden by a covering of skin, but in the latter it is always uncovered. The foot, which may be broad and flat, thin and long or divided into a number of arms, is often very highly developed, and may be employed for such various purposes as crawling, burrowing, swimming, and even leaping.

The economic importance of the molluscs is considerable, many being edible, whilst their shells have been put to endless uses as ornaments, ingredients in cements and plasters, the basis of gravel paths, dyes, and, before the advent of coins, a medium of exchange.

The marine molluscs suitable for exhibition in the aquarium make a rather short catalogue, but include some interesting and beautiful examples, representative of each of the following four subdivisions into which the group is split up. These subdivisions are: (1) The *Gastropods*—snails, slugs, limpets, whelks, etc.; (2) The *Pelecypods*—the bivalves; (3) The *Scaphopods*—the toothshells, and (4) The *Cephalopods*—octopus, squids and cuttlefish.

The Gastropods, which are represented on our coasts by a large number of species, of which the whelk, limpet, winkle, and sea-hare make the most suitable aquarium exhibits, are all hatched with a

shell that may persist throughout life, degenerate into a mere scale, or disappear altogether. Some pass through a number of larval stages, whilst others begin life with an unmistakable family likeness.

The Limpet, *Patella vulgata*, is remarkable for its strongly developed homing instinct. Its strong shell forms a scar upon the rocks, which, with the aid of secretions produced from the animal, in time forms a shallow, but quite distinct pit. When covered with water as at high tide, the limpet sallies forth in search of food, returning to its little "dug-out" before the rock upon which it lives is exposed at low-water. Like many other vegetable-feeding molluscs, the creature is an efficient window-cleaner, and in the aquarium when promenading on the glass of its tank, the operations of its file-like tongue can be seen to advantage. This tongue is a ribbon which exceeds the shell in length and bears more than two thousand saw-edged teeth arranged in rows, the broken or worn-down teeth being replaced by new ones from the ranks behind. The tongue is coiled like a watch-spring, and when in use makes a scratching sound which is clearly audible through the glass front of the tank. The remarkable adhesive powers of the limpet are not only proverbial but true, scientifically conducted experiments having proved that the creature is able to resist a pull of over sixty pounds. The limpet is, however, by no means impregnable, for in the large Whelk, *Buccinum undatum*, it has a foe which with its

tongue will drill a neat little hole through its shell.

The whelk is able to close the mouth of its shell completely by means of the operculum,—a kind of horny lid,—a character which distinguishes it from a land-snail. It is further conspicuous for the great development of its siphon, a tube-shaped pipe through which the water is conducted to the gill-chamber, a contrivance characteristic of all marine snails. Its masses of egg-capsules are known to all, being amongst



WHELK (*Buccinum undatum*) AND EGGS.

the commonest objects washed up by the tide. Each of the little capsules contains about 500 eggs, but only three or four sally forth into the world as perfect whelks, as upon hatching the little creatures fall upon each other with murderous zest, devouring their weaker brethren and the unhatched eggs.

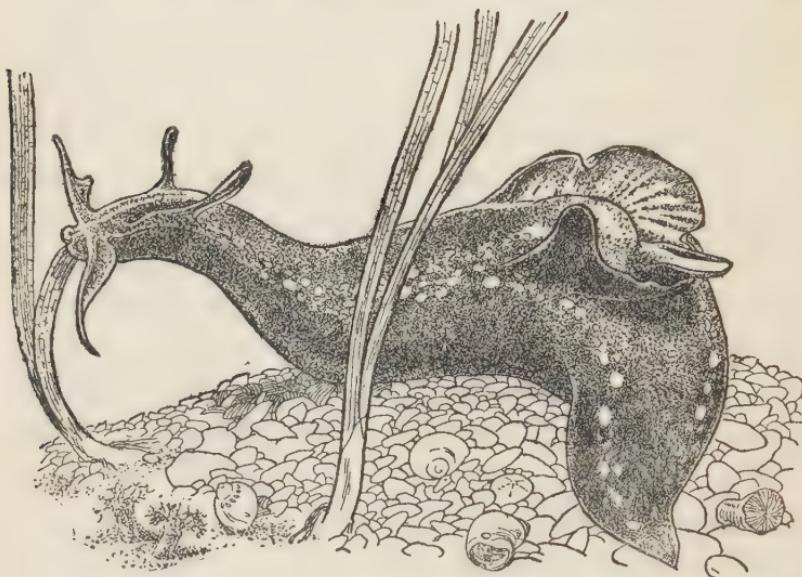
In the Common Periwinkle, *Littorina littorea*, the eggs are laid one or two at a time in transparent capsules, shaped like tiny dish-covers, which lie upon

the sand, or float in the water, hatching out about a week after they have been deposited. The baby winkles, although provided with shells, are at first free-swimming animals in the upper water layers where they stay for some weeks before settling down to browse upon the weed-covered rocks.

A very remarkable mollusc is the Slipper Limpet, *Crepidula fornicata*, which may be gathered in immense quantities off our coasts, especially in the Thames estuary. A native of America, fifty years ago it was unknown in this country. One evil day it came to England attached to some oysters, and now it is so firmly established that it is causing the greatest havoc in the oyster-beds where its presence is partly responsible for the big rise in the price of the bivalves during the past few years. When we consider that a single individual can lay more than twenty thousand eggs at a sitting its abundance is not to be wondered at.

The Sea-Hare, *Aplysia punctata*, which is quite common off the south-western coast, derives its popular name from a fancied resemblance to a crouching leveret,—not to its fleetness, for it is a decidedly sluggish creature. It is a slug-like animal, dark brown in colour, and having a thin internal shell covered by two great flaps of the mantle which can be considerably extended at will. The mantle, it should be explained, is present in all molluscs and is responsible for the building of the shell, which consists of several layers, the outermost being usually thick and

limy, and the innermost having an enamelled surface of "mother of pearl." The shell of the sea-hare is of little service to its owner, but in its power of ejecting great quantities of purple ink it has an efficient means of protection, for this ink or dye acts upon the principle of the war-time "smoke screen," and by the time the water has cleared the animal has



SEA-HARE.

made good its escape. The sea-hare is a purely vegetable feeder, and in its native state lives principally upon Sea-grass, *Zostera marina*, which it eats by biting off pieces about half an inch in length and swallowing them whole. In the aquarium it will thrive for short periods on ordinary lettuce.

Many of the true sea-slugs do well in aquaria.

Their gills are naked, and carried in rows upon the animals' backs where they display all manner of fantastic tree-like forms, some of them being gorgeous in the extreme.

The Sea Lemon, *Doris tuberculata*, closely resembles a large lemon cut in half, lengthwise, with a pair of short thick horns at one end, and a crown of gill-plumes at the other. It lays its eggs in the form of ribbons which are fastened to rocks, and arranged in a coil. They make interesting objects for study under the microscope, for it will then be seen that each egg contains three or four young that move about freely by means of rows of vibrating hairs, and that they are provided with tiny spiral shells—a remarkable sidelight upon the probable ancestry of the sea-slugs. The adult "lemon" has a digestion which an ostrich might surely envy, for it feeds mainly upon the "crumb of bread" sponge, and its stomach upon dissection will be found to be crammed with the sponges' hard spines and needles.

The Plumed Sea-Slug, *Eolis papillosa*, is a species which will flourish in the aquarium upon a diet of small anemones, and one can but marvel at the strange nature of its food, for the anemones' countless stinging cells are fatal to most small animals, and highly repellent to quite large fish. Its gill-plumes are arranged in rows upon its back, and cover the entire length of the animal. They harmonize perfectly with the tentacles of the anemones upon which the slug browses.

The *Pelecypods* are probably economically the most important of all the molluscs, since a very large number of forms are regularly used as food, and several produce pearls. All have the shell made in two—usually equal—halves, joined by means of a cartilaginous hinge. They include some of the minutest, as well as the largest of all molluscs with external shells.

The visitor to the Zoo aquarium will not fail to notice in some of the large tropical marine tanks, oyster-like shells large enough to make the most admirable hip-baths. These belong to the Giant Clam, *Tridacna gigas*, an animal of gorgeous coloration, and large enough to make a square meal for at least fifty persons. It hails from the barrier reef, where it lies partially sheltered in the sand, and truly ghastly stories are recounted of divers walking on the reefs who have accidentally placed a foot between the half-opened shell, when instinctively the valves close in a vice-like grip. The remainder of the story can be left to the reader's imagination.

Similar tragedies on a minor scale occur every day on our coasts where large mussels close upon the toes of some inquisitive bird that, however, usually manages to escape by parting with the member thus detained. The shells of the giant clam and other molluscs inhabiting the barrier reef can be introduced into large tropical aquaria with good effect, being consistent with the exhibits and giving just that

touch of local colour requisite to make the tank a complete and convincing picture.

The Oyster, *Ostrea edulis*, the Cockle, *Cardium edule*, and the Scallop, *Pecten maximus*, are all of great importance in the national larder and are too well known to need introduction. Every year there is delivered at Billingsgate Market alone over one thousand tons of oysters, and a hundred tons of cockles and scallops. Many a romance might be written around the oyster alone. It bulked largely amongst the many lures which brought the Roman legions northwards, and it has formed the bedrock of fortunes, only exceeded by those amassed from the culture of its near relative the pearl oyster. Its life-history is very extraordinary, and has given rise to a vast library, and many parliamentary reports. We must condense our account into a single paragraph. The sexes are combined within the parent oyster, but do not mature simultaneously. An oyster can be female for a short period, and then male. It may contain about two million eggs which when the time is ripe are violently ejected from the parent, and are shot upwards in a cloud, to take their place in the vast congress of larval sea-animals which spend their infancy at or near the surface of the ocean. At this period in their existence from between the valves of the baby oysters there protrudes two flaps fringed with never-resting hairs and by means of these the little creatures swim nimbly about, until they fall, as do the

majority, beneath the claws or stinging cells of their many foes. Very few of the original two millions survive to adult oysterhood, but the gourmet may spare his regrets, for if every oyster were to attain maturity the whole of the world would in a very short time become covered with the piled-up shells of the bivalves. Such of the young oysters as survive a twenty-five days' sojourn at the sea-surface sink at the end of that time to the bottom where they fix themselves to any convenient object. When quite young the shells of the oysters are of equal size and both flat, but at this stage one becomes concave. The substance to which the mollusc attaches itself may determine its destiny for good or evil, and hence the floor of an oyster-bed is always carefully prepared. With all the care lavished on our oyster harvests, even the adult animals continue to suffer very severe depredations—from starfish, sea urchins, whelks, boring sponges, slipper limpets, and certain fish, and it would appear as if Nature is determined to maintain the balance without regard to man's effort to protect any particular animal.

The Edible Mussel, *Mytilus edulis*, enjoys a world-wide distribution, and whilst of great food value must be gathered with discretion since it can live under conditions of impurity which would prove fatal to most molluscs. This fact has its advantages for the aquarist, for the mussel is a most valuable "filter." Like most bivalves it is the possessor of two siphons,

through one of which it takes in water, extracting from it all manner of organic substances, whilst through the other it expels the purified water.

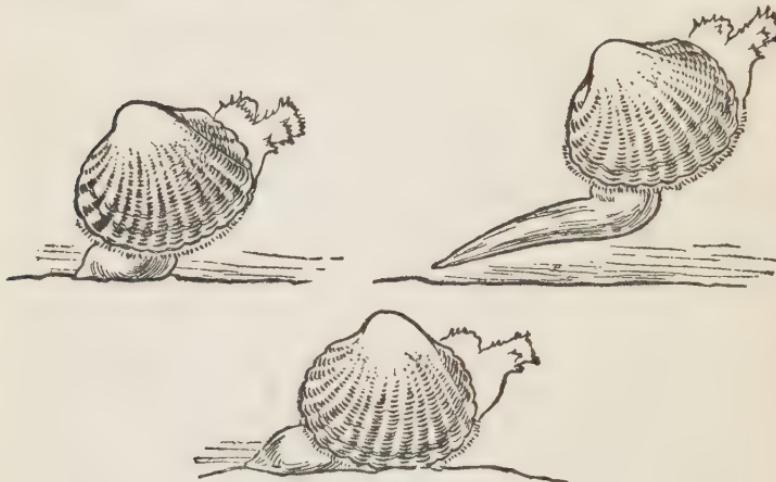
Unlike the oyster which anchors itself by cementing part of one of its shells with carbonate of lime to any convenient support, the mussel attaches itself by a number of threads which often form a large tuft of minute cables.

In one British bivalve, the large Fan Mussel, *Pinna fragilis*, these threads are so abundant and of so fine a texture that they can be woven into scarves and other garments. This mussel, which is horn-coloured and more or less transparent, is often the host of a curious little crab, *Pinnotheres*, which secretes itself within the shell of the mollusc. Should the crab die within its host, the mussel proceeds to bury its guest in a covering of the pearly nacre with which its shell is lined.

The Common Cockle is without doubt the most entertaining of all the bivalves, for it is the possessor of a large scarlet or orange foot with which it can burrow in the sand, hook itself to stones, or take the most astonishing leaps. This champion long-jumper simply presses its muscular foot against a stone, and by stiffening it suddenly projects itself for several feet. As a result of such a performance, people strolling along the gravel reaches of the seashore have frequently imagined themselves pelted with stones owing to hundreds of cockles leaping in unison to meet the incoming tide. To those not acquainted

with the habits of the cockle, the phenomenon, when it occurs at night upon a desolate beach, may be distinctly disconcerting.

The beautiful Scallop which has been so often immortalized and travestied in ornament can be kept with some success in aquaria. Whilst most



COMMON COCKLE, LEAPING.

bivalves are only capable of distinguishing between light and dark, there are grounds for believing that scallops enjoy a much more efficient "eyesight," for any sudden alarm, such as the introduction of their deadliest foe, a big starfish, produces a most dramatic effect upon the part of the molluscs, which rise from the sandy floor and flap through the water at a considerable speed. This "flitting" is effected by the rapid opening and shutting of the valves of the shells. In early life they are much given to this means of

progression, but with advancing years they become more staid and sober, only making use of their leaping powers upon emergency. Like the oyster, the scallop requires about four years to attain maturity.

From time to time there may be seen suspended or floating in the tanks of public aquaria pieces of timber riddled with innumerable burrows, which the official label informs us are the work of the Ship-Worm, *Teredo navalis*. They are, however, not the work of a worm at all, but are merely annexes to the dwellings of certain bivalved molluscs. We know that a number of bivalves burrow, in the sand or mud ; the ship-worm, however, has a taste for timber. But to whatever depth it may dig to escape its foes it must still keep in touch with the outer world for breathing purposes, and to effect this the siphons are of enormous length.

Beginning life as a free-swimming larva, this strange mollusc soon settles down and starts boring a tube into some convenient harbour pile or wooden ship. As it grows, tunnelling the while, the tube naturally becomes longer and longer and the siphons stretch. The two valves of the shell, which originally resembled those of a small cockle, degenerate into mere plates, but the tube continues to grow. Our native ship-worm can drive a shaft, nearly a foot in length, through the hardest timber, in under eight months, whilst certain foreign species may penetrate for a distance of over four feet. To-day, when steel-plated ships are the rule rather than the exception, the ship-worm

is not the menace that it was in days when it rotted the timbers of Drake's *Golden Hind*, or sufficiently destructive to merit the name "calamitas navium" originally bestowed upon it by Linnæus.

The "head-footed" molluscs or Cephalopods are represented to-day by the Octopus, Cuttlefish, Squid, Nautilus, and Argonaut. That in geological times they were far more numerous than they are now is proved by the fact that many of the rocks are built up of the remains of such shell-bearing forms as the ammonites. But although less numerous the living forms are so extraordinary, both in their habits and appearances, that they never fail to excite our wonder, and in the aquarium their exhibition may be counted upon to attract a large and speculative public. Unfortunately these animals require a greater amount of oxygen to keep them in health than any other marine animal, and as they make a habit of contaminating their travelling tanks by expelling a quantity of inky fluid, few ever arrive alive at inland aquaria.

The Octopus, *Polypus vulgaris*, which has ever been a prime favourite with the sensation-monger, and has fairly eclipsed the sea-serpent as a "silly season" topic, seldom exceeds a length of 8 feet in British waters, or more than 40 feet in tropical seas.

The long tapering arms of the animal represent the "foot" of the whelk or garden snail, which is in the case of the octopus divided into eight whip-like tentacles, each having its undersurface thickly studded



OCTOPUS.

S. R. BRIGHTWELL.

with about three hundred circular sucking discs. In the centre of the arms is the mouth, a horny structure shaped like a parrot's beak. The head is separated from the body by a slight constriction, and bears, in addition to the arms, two medium-sized eyes. The more or less globular-shaped body is small in proportion to the rest of the animal, and is enclosed in a fleshy covering which is analogous to the mantle of other molluscs. From it protrudes the siphon pipe which draws in water to vitalize the gills, and sustain the creature. On the water being exhausted of its oxygen it is expelled by the siphon with considerable force, and the current thus generated can be utilized to "blow" away the gravel or sand from the sea-bed until a convenient basin-shaped resting-place is obtained. The siphon further plays an important part in the locomotion of the octopus, for when in a hurry, or engaged in a long-distance swim, the creature relaxes its arms from their habitual hold upon the sea-floor, places them close together before the eyes, forming a dart-like formation, and breathes heavily and hurriedly. As a result the water is expelled with extra force and the animal can thus propel itself backwards through the water at a speed of several miles an hour. Sometimes the octopus, looking like a number of snakes hopelessly entangled with each other, is content to slowly writhe through the water; on other occasions it will stride spider-wise over the rocks until it catches sight of a crab or other crustacean, when it will rise

OCTOPUS



and then descend bodily upon its victim. It is an animal beautifully adapted to approach its quarry unobserved, and to avoid detection by its foes. No other creature ashore or afloat, not even the chameleon, is possessed of better powers of "camouflage," for the lax and pliant skin of the octopus, which is normally of a terra-cotta tint, can within a few seconds be made to match the colour of its surroundings.

Under no circumstances will the small octopus of our seas deliberately attack human beings, and any casualties that it has ever been responsible for have been due entirely to the shock aroused by its sinister appearance.

The octopus lives entirely on crustaceans and other molluscs, displaying the greatest artfulness when tackling its prey. A big crab or lobster is usually approached from behind, and the attacker after much manœuvring eventually secures the claws. The battle is then virtually over. Its patience when opening oysters is Job-like, and the creature is said, when this feat is almost accomplished, to place stones between the half-open valves to prevent them closing again. The staple diet of the octopus is, however, crabs, and to secure these he retreats into a rock-fissure which commands a good view of the surrounding country. On the approach of his victim the octopus extends one of his arms, and then gently flicks the crab with the tip, just between the eyes. The crabs appear to become hypnotized by this procedure and allow themselves to be drawn unprotesting into the operating

chamber, where if they are not eaten straight away they are kept until required. Of its many victims, only the lobster offers the slightest resistance. When actually feeding, the octopus neatly disarticulates its prey, and then proceeds to remove the flesh with the end of its tentacles, and an untidy pile of crab shells usually marks the entrance to its lair.

The octopus occasionally comes to the aquarium as a result of having investigated the interior of a lobster-pot and failed to find the exit.

Very similar to the above in general structure is the Lesser Octopus, *Eledone moschata*, which derives its specific name from a powerful odour of musk which it emits when handled. It is distinguished from the common octopus by having but a single row of suckers on each arm, instead of two.

Both *Polypus* and *Eledone* are migratory creatures visiting our northern shores only during very warm weather. They winter in the south. In the autumn they may occasionally be caught off the Channel Islands and the French coasts in fairly large numbers, their flesh being used for food and bait.

The Cuttlefish and Squids differ from the octopus in the possession of ten arms and having the boat-shaped bodies supported by an internal shell of a calcareous or horny nature. They have two extra long arms which bear suckers only at their club-shaped tips, the entire apparatus being neatly coiled up when not in action, and stowed away in two pockets, one on either

side of the creature's head. Should a fish approach, the arms are "run out" with lightning-like rapidity and the prey is secured by the suckered tips. Cuttle-fish and squids rely wholly upon fish for their support, and unlike the octopus, which is rather sparing of its ink and usually a mere "passive resister" when attacked, will eject their ink on the slightest provocation. When handled they are quick to use their sharp beak-like mandibles. The skin of these animals is richly supplied with colouring matter which is under the direct control of the animal, but unlike that of the octopus is more or less rigid and cannot be drawn into folds. The long body is surrounded with fins which by a winnowing motion help to propel the animal forward. Sometimes the fins are so highly developed that by means of them the animal can take flying leaps out of the water, on which occasions it sometimes lands on the decks of vessels. There are plenty of "big squid" stories—some apparently not without foundation—as specimens with bodies measuring nearly 20 feet in length, with arms to match, have on more than one occasion been cast ashore off the coasts of Newfoundland and the west of Ireland. Such monsters have eyes 15 inches across, suckers as big as saucers, and jaws that dwarf the beaks of the largest known vultures. Most Cephalopods are hatched from eggs which are laid attached to a common stem like a bunch of grapes, and are securely anchored to a rock. The young on hatching out resemble their parents.

The Common Cuttlefish, *Sepia officinalis*, is abundant off our sandy shores, and is often taken in the shrimp trawl, and seine net. It makes an ideal bait for most fish, and its firm opalescent flesh is not at all unpalatable when properly cooked. The well-known "cuttle bone" lies in the living animal just beneath the skin of the back, and is made of innumerable overlapping limy plates.

The Squid, *Loligo forbesi*, is a frequent summer visitor and is a near relative of the giant forms which occur in deep water. It has a flexible horny "pen" in place of the cuttle's limy "bone," and provides us with the "sepia ink." Squids live in vast shoals which manœuvre with military precision, and in Italy where the majority are captured for commercial purposes they are netted or speared. Sometimes branches are suspended in the water and the animals on approaching to lay their eggs on them are surrounded and caught. Another ingenious method of capture employed by the Italians is by means of towing a female squid behind a boat, when the males gather round in their hundreds.

The TUNICATES, some of which are popularly known as sea-squirts, are present everywhere in the sea, and frequently appear in the aquarium where they will be dismissed by the casual observer as being either vegetable growths, or at the best unattractive relatives of the more beautiful anemones. In reality they are

of the utmost interest, for they are more closely akin to ourselves than the largest of octopuses or most lively of lobsters. They are creatures that have halted on the road of evolution,—degenerates who have stopped half-way, standing for ever between those animals that have been endowed with a well-developed spinal column, and the great army of invertebrates.

The name “tunicate” refers to the leathery or gelatinous tunic in which the animals are enclosed, whilst the popular term “sea-squirt” refers to their habit of violently ejecting a thin stream of water when molested as they cling to the rocks at low tide.

Every animal in its youth gives us a hint of its early ancestry, and our chief interest in these creatures lies in their infancy. Whilst still within the egg, or parent, a typical tunicate passes through several stages. It begins as a single cell, and slowly developing presents succeeding phases which recall certain higher forms of life. It is usually hatched from one of many eggs and makes its first public appearance as a free-swimming, tadpole-shaped creature, having a brain, an eye, the means of hearing, and a well-defined nerve chord, foreshadowing a spinal column, from which such ponderous vertebræ as those of the whale may originally have sprung. This minute creature leads a care-free existence for a few days, and then its early promise ends. Settling at the bottom of the sea, where it anchors itself for life, it loses its tail, eye and “ear,” acquires a tough leathery tunic and becomes

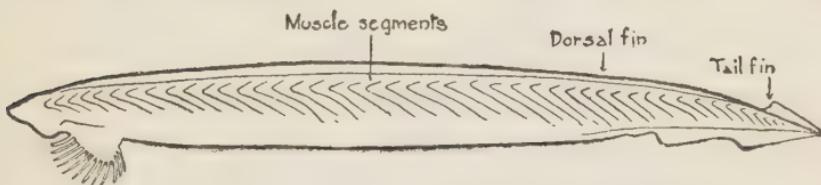
a mere sack incapable of further travels. A tunicate, *Oikopleura dioica*, which is common in home waters, differs from the majority in remaining in the "tadpole" stage throughout life. It is known as the "house-builder" from its habit of constructing gelatinous barrel-shaped houses in which it floats about. By far the greater number of tunicates live as "fixtures" secure within their jackets which are fitted with two openings, the one aperture acting as an inhalent, the other as an exhalent. The interior of the animal is lined with minute vibratory hairs which sweep particles of food—microscopic plants and animals—into the stomach and also ensure an ever fresh supply of water passing over the innumerable gill-slits. The heart is unique in being a reversible engine, pumping the blood first one way, and then, after a short interval, in the opposite direction. The blood-flow is consequently continually changing direction.

The large Tube Sea-Squirt, *Ciona intestinalis*, abundant on all our coasts, is a rather handsome creature of graceful flask-like form, apple-green in colour, with the rim of each opening tinted orange. It grows to a height of over a foot.

Very striking are the tunicates which live in colonies, and are known by the name of Golden Stars, *Botryllus violaceus*. They form great star-spangled masses presenting an endless range of brilliant and contrasting tints, the gelatinous sheets of stars covering weeds, rocks, shells, and sometimes even the backs of crabs.

Each star represents an individual, yet all are connected one with the other, and share a common blood-circulatory system. They reproduce both by budding as in the case of the anemones, and by means of eggs.

A closely allied form which makes a very striking exhibit in the aquarium is the red-coloured *Leptoclinum lacazii*, and its appearance on the rocks may be gathered from Victor Hugo's reference to it in the *Toilers of the Sea*, where in describing a sea-cave he states "the



LANCELET OR AMPHIOXUS (*Branchiostoma lanceolatus*).

walls were splashed with crimson stains as if giants had been fighting there."

The tadpole-shaped Lancelet or Amphioxus, *Branchiostoma lanceolatus*, a creature at one time regarded as a fish, is allied to the sea-squirts, but still higher in the scale of life, being provided with an elastic rod—the notochord—which runs along the entire length of its head and body. It feeds and breathes exactly as do its less important relatives, namely by means of vibratory hairs which sweep the water into its interior.

The lancelet can swim with ease in either direction, but during the daytime prefers to remain buried in the sand, where it is securely hidden unless dug up by a wandering crab, or the all-investigating naturalist.

CHAPTER II

FISHES

IN reviewing the fishes generally shown in large marine aquaria we shall begin with the sharks,—not because they are the largest fish afloat, but by reason of their structure which establishes the fact that they are far behind the majority of living fish in development, and ruled the seas long before most of the modern forms were evolved. “Shark,” it should be explained, is a loose term applicable not only to those gigantic man-eaters which are so justly dreaded, but likewise to the many kinds of comparatively small harmless dog-fish. A dog-fish is a small shark, and a shark is a big dog-fish.

All these fish have scaleless skins, the lack of scales being compensated for by the presence of millions of tiny knobs, or needles, which form a hard, rasp-like surface calculated to turn the teeth of most fish, and sometimes even the point of a knife or harpoon. The skin can be converted into a leather (shagreen), and is used for polishing wood, ivory, and metal. Indeed, man gets his own back on the shark for all the loss it incurs to human life and property, for not only is the fish’s skin put to many uses, but its teeth are converted

into ornaments, its spinal column into walking-sticks, its fins into soup, its liver into oil, its flesh into a variety of dishes, and any part left over may reach the public in the form of a patent medicine or fertilizer.

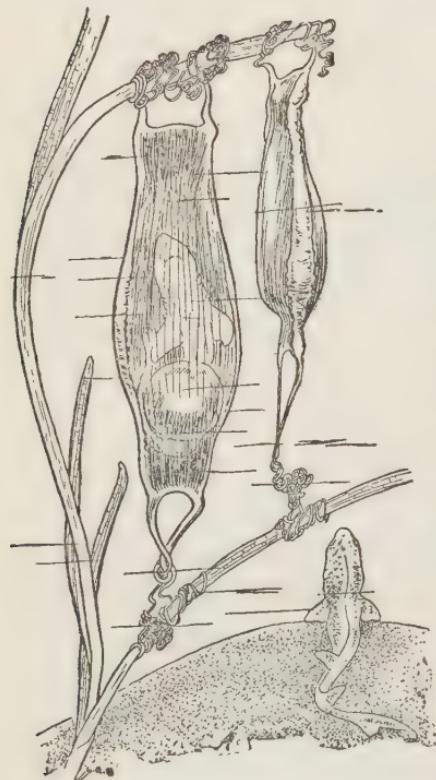
In the members of the shark family the mouth is situated on the undersurface of the head, whilst the neck is provided with five or more gill-slits on each side, but no gill-cover as in normal fishes. The lobes of the tail are unequal, the upper, through which the backbone passes, being the larger. In the aquarium quite small sharks and dog-fish appear to great advantage and do well. Large specimens cannot be exhibited, as apart from making serious inroads on the weekly food-bill, they take up too much "elbow room."

Unlike the majority of true fishes which lay their eggs by the thousand or even million, sharks and dog-fish seldom bring forth more than twenty or thirty young. Sometimes these are born alive, but more frequently they are launched upon the world in amber-coloured flask-shaped horny cases, which are anchored to seaweeds by means of long tendrils. The baby dog-fish can be clearly seen in all stages of development through the transparent walls of the egg-case, and when hatched is indistinguishable from its parents in general appearance, save for the presence of a feeding bottle which it carries in the form of a yolk-sack, attached to its undersurface. As soon as the yolk-sack is absorbed, the fish embarks upon a life of destruction which has earned it a bad name amongst fishermen.

Less than twenty years ago the dog-fish was regarded as a mere nuisance, but as a result of investigations by the Ministry of Fisheries the excellence of its flesh has been firmly established, and to-day enormous quantities are brought to the market.

The forms usually seen in aquaria are mostly southern ones, such as the Spur-Dog, *Squalus acanthias*, the Nursehound, *Scyliarhinus stellaris*, and the Spotted Dog, *Scyliarhinus canicula*.

If the reader can imagine a dog-fish being put through a clothes-ringer and surviving the ordeal, he will have a very fair conception of the appearance of the Skates or Rays. They are shark-like fishes



EGG-CASES OF THE DOG-FISH.

which have spent so much time on the sea-bed lying half-buried in the sand, that they have become extraordinarily flattened. The details in which they differ from the sharks and dog-fishes are comparatively

slight, and fundamentally the two forms, although so dissimilar in outline, are built upon the same plan.

The Monk-Fish, *Squatina angelus*, so called from the resemblance of its rounded head and broad pectoral fins to a monk's hooded cowl, is too flat and "splayed" to be a dog-fish, and too narrow to be a true skate. It swims like a shark by means of its tail and not by undulations of its large breast fins as do the skate. It feeds however in the manner of a skate, lying half-buried in the sand and arresting passers-by that are not too large to be swallowed whole. Angel-fish, Fiddle-fish, Monk, Puppy, Buffoon are only a few of the printable names by which the fish, which may attain a length of over 5 feet, is known to the trawlemen who bring it to market where its carcass, after being dismembered, is sold under some name that sounds attractive to the public. The true skates or rays are all edible and of great food-value, being next to the herring unrivalled in the amount of nutriment contained per fish. Some grow to a huge size, and all are beautifully decorated with patterns of infinite variety.

The peculiarly broad form of the body, which is compressed from above and below, is due to the extraordinary development of the breast fins, which extend nearly to the tip of the snout, passing over the gill-slits which are situated on the lower surface. As in the case of most dog-fish, skates produce their eggs each enclosed in a horny envelope. These, however, are rectangular in form and have a horn or handle at each

corner which serves to anchor the egg-case to weedy rock-fissures. Slits in the horns admit the free entrance and exit of the sea-water, which as the embryo develops is further aerated by the rhythmic movements of the little creature's tail. The egg-cases vary much in size according to the species, some seldom exceeding 3 or 4 inches in length, whilst others such as those of the Bottle-nosed Skate, *Raia marginata*, may attain a length of 18 inches. The rate of incubation depends to a large extent upon the temperature of the surrounding water and may vary from four to ten months. Just how many eggs are laid per skate is still a matter of conjecture, but one in the Plymouth aquarium was observed to lay thirty in the course of six weeks. In common with those of the dog-fish, the empty egg-cases which are so frequently washed up on the shore are variously known as mermaids' purses, pixie purses, and sailors' purses. Skates are fascinating creatures in the aquarium in which they glide over the sand, and flap their huge pectoral fins when swimming in a manner suggestive of giant bats. Further, the resemblance of their undersurface to a grotesque human face makes an irresistible appeal to the frivolous spectator.

About a dozen species of skate are commonly used for food in this country, all of which frequently make an appearance in the aquarium where they may live for several years. The largest is the Bottle-nosed Skate which may reach a length of 9 feet and an equal width, and weigh nearly 5 cwt. Such monsters



THE DOGFISH AND SKATE TANK.

[Facing p. 98.]

naturally require an enormous amount of food to sustain them, and one recently examined was found to contain 'three mackerel, two skate over a foot in width, a four-pound lobster, a coal-fish, a quart of assorted crabs and a number of small plaice. Some of the skates, such as the Whip Ray of tropical seas, have large barbed spines on their tails, capable of inflicting poisonous and often mortal wounds. Our own Thornback Ray, *Raia clavata*, is armoured all over with sharp thorns that make it a dangerous fish to handle, whilst the sickle-shaped blades in the claspers of the male can do terrible damage to the hand that incautiously seizes them.

The Torpedo Ray, *Torpedo marmorata*, is occasionally met with off our southern coasts. It is unique in that it is our only native "electric" fish, being provided with a veritable galvanic battery capable of giving very severe shocks. The electric organs which are kidney shaped and are supplied with numbers of branched nerves are situated on either side of the head, and occupy the whole thickness between the upper and the lower surface. They give rise to a very strong electric current which will make an electric lamp glow, render the needle magnetic, and emit a spark. In mediæval times the fish was used as a cure for rheumatism, the patient being made to stand barefooted on the living fish.

We shall now consider the typical bony fishes beginning with the members of the Herring-family, which

are unfortunately seldom represented for long in the aquarium. Nothing short of the open sea is apparently large enough for these free-rangeing fish, for kept in a tank they will swim round and round, each fish nibbling at the tail of the fish immediately in front. At Brighton it was found that the herring-shoals introduced into the aquarium became so panic-stricken that they dashed themselves against the glass. To obviate this a large rock was erected in the middle of the tank, with the result that the fish resigned themselves to swimming round it, continuously day and night, doubtless under the impression that they were steadily moving forward.

The Herring, *Clupea harengus*, in captivity is apt at night to collide with the rockwork of its tank, which should therefore be faintly illuminated. It is a very prolific fish, which is fortunate when we consider that nearly three hundred thousand millions are landed annually in Great Britain alone. Less than one-quarter of these fish are for home consumption, the remainder being exported to foreign countries. From the fishery point of view, next in importance to the herring is the Pilchard, *Clupea pilchardus*, which in its young state is known as a sardine. Like the Sprat, *Clupea sprattus*, another member of the herring-family, it has no place in the aquarium for long, where its chief value lies in its use as a source of nourishment for hardier exhibits.

The Conger, *Conger vulgaris*, is the largest member of the eel-family, females sometimes measuring over

8 feet in length, such specimens weighing about 130 lbs. Whilst common inshore, frequently invading lobster-pots, when the spawning season arrives it goes far out into the deepest parts of the Atlantic, there to deposit some eight million eggs. Lurid stories have been told of giant congers attacking divers, whilst the fish has frequently been known to fairly monopolize a small boat when hauled on board by anglers more courageous than skilful. In the aquarium it makes an attractive exhibit, becoming so tame that at feeding time even large specimens will not only take food from the hand, but suffer themselves to be lifted bodily out of the water.

The Pipefishes and Sea-horses are perhaps the most popular of all the marine aquarium fishes, their grotesque forms and quaintly dignified movements at once stamping them as unique. Their family affairs are further unparalleled in the fish realms of "child welfare." In the breeding season the female of most pipefishes and all sea-horses places the eggs, one at a time, in an abdominal pouch with which the male is provided, the pouch consisting of overlapping folds of skin. The eggs are carried by the male until hatched, when the infant fish follow their parent for some time, often resting themselves by taking a turn with their long prehensile tails round any convenient part of their father.

Four species of pipefish, the Great Pipefish, *Syngnathus acus*, the Broad-nosed Pipefish, *Siphonostoma*

typhle, the Ocean Pipefish, *Nerophis aequoreus*, and the small Worm Pipefish, *Nerophis lumbriciformis*, are common off our shores, where they abound in banks of sea-grass. They are very attenuated in form and harmonize perfectly with the trailing ponds of the weeds amongst which they live. The male of the Ocean Pipefish has no abdominal pouch, the eggs being carried, glued by a sticky secretion which it exudes, to the undersurface of its body.

In the pipefishes the tail is only slightly prehensile, but in the Sea-horse, *Hippocampus antiquorum*, it forms as efficient a grasping organ as that of a spider monkey. Sea-horses, which recall the knights of the chess-board, swim in an upright position by means of their fan-shaped fins working on the principle of the screw-propeller, the movement being quite rhythmical owing to each of the fin-rays striking the water in succession. The Sea-horse, which is very common in the Mediterranean and the Bay of Biscay, is a rare visitor to our shores. Those in the Zoo aquarium are obtained from Arcachon. They are conveyed to Paris by train and from there, in order to shorten their journey, are transported by aeroplane to London. The provision of suitable food for these quaint creatures at first presented something of a problem, for the minute marine crustacea which when at home the "horses" suck into their tiny tubular mouths could not be obtained in sufficient quantities. Eventually the common fresh-water "flea," *Daphnia*, was found to form an excellent



THE PIPEFISH AND SEA HORSE TANK.

Facing p. 102.]

substitute. It will not live more than five minutes in salt-water, but the sea-horses seldom give it a chance of dying by drowning.

In striking contrast is the Grey Mullet, *Mugil capito*, which in conformity with its torpedo-shaped body is remarkable for the rapidity of its movements. It is a sociable fish often entering estuaries in large shoals, in search of the weedy growths which harbour the small crustaceans upon which it feeds. Its thick soft lips are well adapted for browsing, and its rather bird-like stomach for grinding crustaceous shells. The agility of the fish is proverbial, and it will often evade the net by leaping high above it. A shoal which a few years ago penetrated some miles up the river Arun on being cornered in a small backwater made such desperate attempts to escape that most of the fish flung themselves high and dry upon the bank. In the aquarium the Grey Mullet does exceedingly well, specimens having been recorded to have lived for over ten years in captivity.

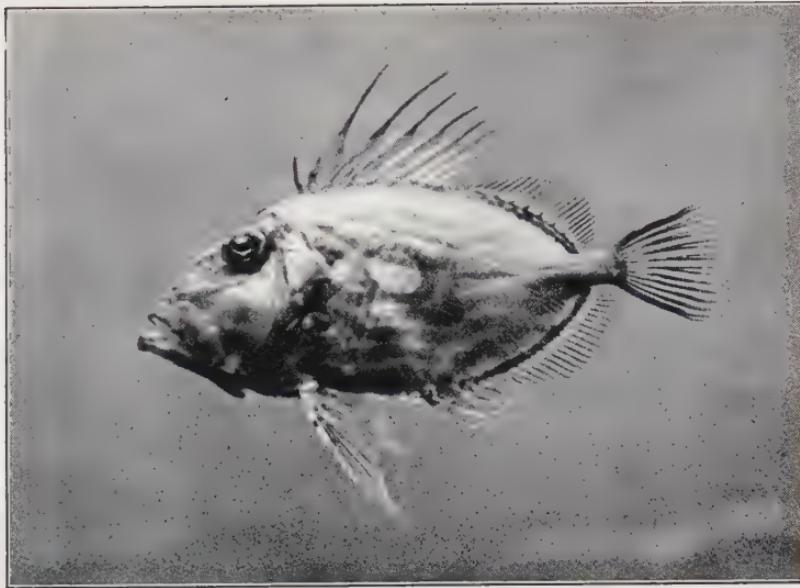
The Cod, *Gadus marrhua*, with the exception of the Ling, *Molva vulgaris*,—a fish which does not thrive in the aquarium—is the largest representative of a very important group. Not only are all the members of the cod-family edible, but their livers yield valuable oils, and their swim-bladders many grades of isinglass.

In the aquarium the cod forms a striking contrast to the colourless mass of flesh upon the fish-stall which bears its name. The upper surface of its body gleams

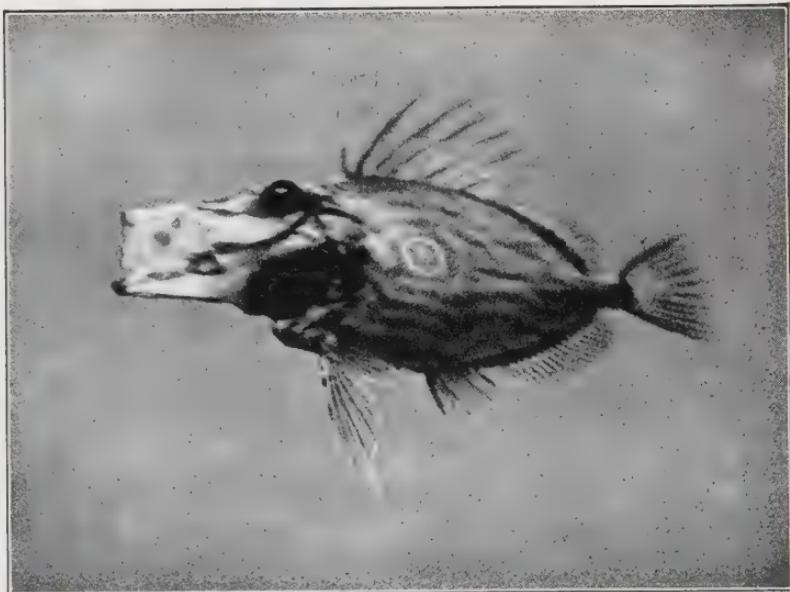
with vivid green and golden brown, shot with little blotches of pearly white, whilst its silvery undersurface shines with delicate prismatic tints. It is a powerful swimmer, and its gem-like eyes are assisted in the search for food by the long barbule depending from the lower jaw, which acts as a probe. Twisting and shooting in all directions it searches the sand until it finds a shrimp, crab, or flat-fish. Few things come amiss to the cod. Various kinds of fish, crabs, lobsters, cockles, octopods, tin cans, and portions of seamen's boots,—all these and still more have been found in the cod's interior. Like the herring it is a migratory fish, and very prolific, laying up to eight million eggs at a "sitting." In the aquarium the cod will thrive, provided the water is kept cool, during the summer months. The Whiting, *Gadus merlangus*, is a shallow-water form that does well in aquaria.

The small Bearded Rocklings—genus *Motella*—of which there are several species, commend themselves to the amateur aquarist, as few creatures, provided they are given plenty of shelter in the form of weeds, stones, and rocky caverns in which to hide away, are more suitable for the small marine aquarium. The fish, which take their name from the barbules which hang from their jaws when quite young, live at the surface, when they are known to the fishermen as "mackerel midges."

The John Dory, *Zeus faber*, is a fish which even the most casual visitor seldom overlooks, for its strange



[Photograph by Neville Kingston.
JOHN DORY.



[Photograph by Neville Kingston.
JOHN DORY.
In the act of capturing its prey.

Facing p. 105.]

form, brilliant colouring, and ludicrously mournful expression make it unforgettable. A ribald observer once suggested that its expression might be the result of the fish having caught sight of its own reflection. Actually it is largely due to the form of its telescopic mouth, which can be extended and withdrawn with lightning rapidity. The John Dory is a strategist and approaches his prey with caution. His body being so compressed laterally as to be reduced to a mere line when seen from the front, he is rarely spotted by his intended victim until too late. As the prospects of a meal become more imminent, bars and streaks of deep chestnut-brown and vivid blue suddenly break out upon his normally gold-coloured sides. Presently his great dorsal fin rises, crowning him with an enormous crest. At the same time the mouth is shot forth and the desired fish or prawn vanishes for ever.

The name John Dory is in all probability a corruption of *jaune dorée*, in allusion to the fish's golden colour, whilst the name of Peter's Fish, which it shares with the Haddock, is attributable to the large circular black spot just behind the pectoral fin,—St. Peter's finger-marks, according to legend.

The eyes of the John Dory, as in certain other fish, are highly mobile and move independently, thus helping in giving a range of quaint facial expressions to which it owes much of its popularity in the aquarium.

A visit to the aquarium will help us to see the Flat-fishes, which include the Halibut, Turbot, Brill,

Flounder, Sole, Lemon Sole, Dab, and Plaice in their true light. Let us trace the life-history of one of them—say the Plaice. The fish is hatched from one of a clutch of half a million eggs. The little creature emerges looking like any normal fish, measuring one-seventieth of an inch in length. The eyes, which are the only noticeable thing about it—for the rest of its anatomy is as transparent and colourless as glass—are very large, and situated one on either side of the head. For some weeks the infant plaice lives at or near the surface of the water feasting on the microscopic plants and animals which there abound. In the course of a few weeks, however, an extraordinary change takes place. The body then shows a tendency to tilt to one side, and the swimming powers of the fish desert it. To meet this distressful state of affairs its “under eye,” i.e. the one turned towards the sea-floor, steadily creeps round the head until it all but meets its fellow. The fish, when it is three months old, has sunk to the bottom to rest upon the sandy sea-bed for good, and by that time it stands a flat-fish confessed, with both its eyes situated close together on the same side of the body. This one-sided view of life has brought about many other modifications, apart from the adjustment of the eyes. The side of the body which lies on the sand through being denied the light has become white, whilst the upper surface, being sensitive to light and richly endowed with pigment cells, has become coloured. Now and again, however, we may come



THE JOHN DORY TANK.

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across a flat-fish with either colouring on both sides, or with part of the upper half white. Some forms swim and lie on the ground with their right side uppermost ; others with the left side. The plaice, like most other flat-fish, can at once adapt itself to its surroundings, and become one with its background, at a moment's notice. Experiments have shown that these fish can "take on" almost any surrounding pattern—that of a chess-board, for instance—with such fidelity as to render themselves quite indistinguishable. In the aquarium, flat-fish not only assume the colour of the sand of the bed of their tank, but partially cover themselves with the same, until only the two eyes, which work independently, protrude from the surface like twin periscopes sweeping the surroundings in search of possible victims.

The Plaice, *Pleuronectes platessa*, which may attain a length of 20 inches, and a weight of 15 lb., is not nearly so common a fish as it was. Its decrease in numbers is due to the steam trawler, which has done much to raise its market value by destroying the ova and young, thus defeating its own ends. To the plaice we owe much of our present knowledge of fish migration. The subject is a romantic one. The survey-ship from a Marine Biological Station trawls for the fish, which when caught are kept in well-aerated tanks on board. Each specimen is dealt with one by one, and embellished with a passport in the form of a disc bearing a number, and giving details of the locality where the

fish has been released. Years later one of the specimens may be caught by a trawler and forwarded to the proper quarters, where its history is elucidated by experts. It is well established that plaice will travel hundreds of miles in search of food and suitable breeding grounds, and that those living in certain localities increase in weight at a far more rapid pace than those emanating from others. Such knowledge has led to a regular system of transplanting the fish, which are "bedded out" on the most favourable grounds.

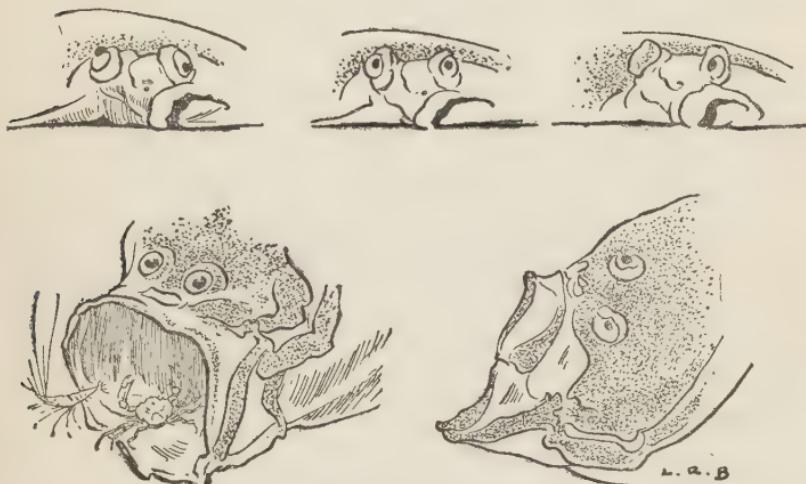
The Turbot, *Rhombus maximus*, one of the largest of the flat-fish, attaining a length of 3 feet, is extremely prolific, the number of eggs that a large female will carry having been calculated at over ten million. The skin of the upper surface of its rounded body is studded with hard, bony knobs. Its coloration is admirably in keeping with its surroundings and the many specimens in the large marine tank in the London Zoo are in consequence often invisible to the public. Turbot become very tame in captivity, and will feed from the hand.

Amongst the hardest of all flat-fish is the much-prized Sole, *Solea vulgaris*, and the Lemon Sole, *Pleuronectes microcephalus*, which although not a true sole, but a species of dab, is often palmed off by the fishmonger upon his unwary or ignorant customer as the real thing.

The Halibut, *Hippoglossus vulgaris*, the largest flat-fish known, specimens large enough to cover a full-

sized billiard table being of frequent occurrence, does not, as a rule, live very long in captivity, and does not adapt itself nearly so well to aquarium life as does the turbot. Like many other delectable animals, the halibut is a foul feeder and is most plentiful in the trawl net after plenty of offal has been thrown overboard from a previous haul.

A hardy member of the Sea-Perch family is the



HEADS OF FLAT-FISH.

beautiful silvery Bass, *Morone labrax*, which may attain a weight of over 30 lb. It is very abundant along the southern coast of England, swimming in shoals quite near the shore. Specimens kept in the Zoo aquarium grow very rapidly on a diet of *Gammarus*, prawns, and flat-fish. Some introduced into the tanks weighing no more than a pound within a year turned the scale at more than treble that weight.

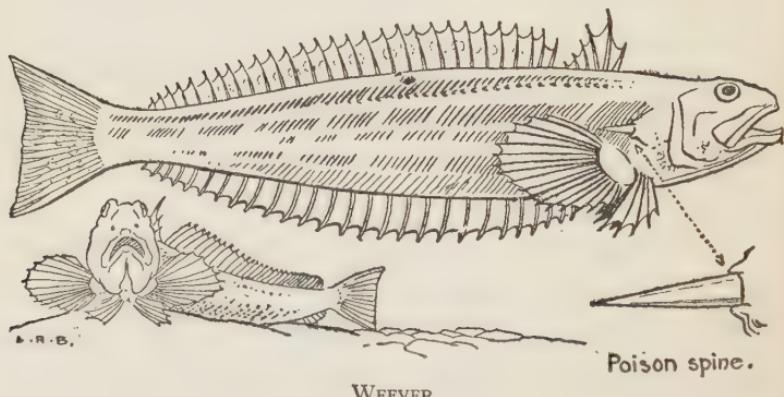
The Wrasses are inshore fishes of ordinary shape and of no food-value. They, however, command our admiration in the aquarium by reason of their brilliant coloration. The peacock's tail, the butterfly's wing,—these and many other wonderful colour schemes are equalled, if not excelled, by the scales of this common fish, for they light up the jade-green of the aquarium tanks with a glow of colour that conjures up visions of coral reefs set in an azure sea.

Scientifically the wrasses are known as "thick-lipped fishes" owing to the fact that they possess a pair of thick "cushiony" lips which conceal a set of teeth that belie the fish's placid expression. These teeth vary in shape, those of the jaws being fang-like, whilst on the palate and back of the throat they are flattened and well adapted for crushing the shells of the molluscs and crustaceans upon which these gaily coloured fish habitually feed. No shell is too hard for a wrasse to tackle, provided there is something edible inside, and it will nibble limpets from a rock or smash to pulp a crab nearly as large as its head with equal gusto and enjoyment. Its table manners leave much to be desired, as when feeding it crunches its teeth and at the same time smacks its lips so loudly that it can easily be heard by the spectator behind the glass of the aquarium. Wrasse lead an exemplary married life, both parents taking an equal share in the making of the home, which they fashion out of scraps of seaweed, the size of the nest depending upon the species respon-

sible for its architecture. The largest of our wrasses—the Ballan Wrasse, *Labrus bergylta*—makes a bird-like nest considerably larger than a crow's, and disperses its eggs haphazard throughout the entire mass. The offspring at first swim near the surface of the water, living upon minute organisms, but as they “come of age” take to the rocky parts of the sea-floor and there crack shells for a living. Some tropical species enjoy such a remarkable set of “grinders” that they actually browse upon the corals as easily as a horse does upon grass. Few kinds of fish do better than wrasse in the aquarium, provided the water is well aerated and suitable food in the form of prawns, sand-hoppers, and crabs is supplied.

The Weevers, a small group of bottom-haunting, sand-loving fish, are provided with poison organs situated at the base of hollow spines, and with these are capable of inflicting very serious wounds. The spines—situated one on the first dorsal fin and one on either side of the gill-cover—are analogous to the poison-fangs of a serpent, being connected with glands which secrete a poisonous fluid. The name “weever,” which is derived from the old English word “wivre” signifying viper, clearly establishes the fact that the fish has been in ill repute for centuries. A weever-sting on the hand may result in the arm swelling to the size of a bolster, and small wonder that the notice “Ware Weevers” is displayed on many of our piers during the height of the holiday fishing season. Two

species are common in home waters,—the Greater Weever, *Trachinus draco*, which grows to the size of an average herring, and the Lesser Weever, *Trachinus vipera*, which seldom exceeds 6 inches in length. *T. vipera* in some localities is exceedingly abundant in shallow water, where it sometimes introduces itself to the incautious paddler. Of the two species the larger is much the hardier in the aquarium.



The Mackerel, *Scomber scombrus*, presents fish-form in its most perfect aspect, for the creature is built for attaining the maximum of speed with the minimum of effort. It has consequently been taken as a model by the ship designer, and by those responsible for the perfection of the submarine and its offspring the torpedo. The mackerel is designed to cleave the water as an arrow cleaves the air. Further, it is all but invisible in its natural element, the wavy pattern of its back blending with the ruffled sea-surface, whilst seen from

below its pearly white undersurface harmonizes with the light from above. It is a very shy fish and like the herring easily becomes panic-stricken, especially when confined in small aquaria or travelling tanks. It is occasionally possible to introduce mackerel into large aquaria situated by the sea such as those at Brighton and Plymouth, where they may thrive for a considerable period. There is, however, little hope of their delighting visitors at the Zoo, or other inland aquarium.

The Gobies are all small inshore fishes, often appearing in such abundance as to fairly choke the shrimp-trawl or seine net. They may at once be distinguished by their two pelvic or breast fins being fused together, so forming a hollow saucer-shaped sucker by means of which the fish are able to adhere to rocks. Apart from this peculiar feature they are very ordinary-looking sand-dwellers, with smooth, almost scaleless skins that harmonize well with their surroundings. Their eyes, like those of most bottom-fish, are placed rather close together, near the top of the head. In accordance with our national extravagance we must follow precedent and state that gobies are valueless as food. The more thrifty nations bordering the Mediterranean, however, deem them otherwise, and regularly bring vast numbers to market where they find a ready sale amongst all classes.

The home life of the gobies cannot fail to interest. Each species appears to have its own particular idea of

an "ideal home," and both sexes participate in its construction. As with most fish, however, the bulk of the family cares fall upon the male. A pair of newly-wed gobies make it their first duty to find a safe site wherein to deposit the precious eggs, and start house hunting. Sometimes a shell is selected, sometimes an empty sea-urchin, or even a bottle. The site selected, the eggs are deposited and carefully guarded by the expectant father. At first the spindle-shaped eggs are all but colourless. Later, as the eyes of the young fish develop, they assume a greenish colour. On hatching they are slightly hampered by their yolk-sac, which, however, is absorbed in under a week, by which time the infant fish can fend for themselves.

The Sand Goby, *Gobius minutus*, shows more independence than his relatives, and is not content to find a house, but selects his own site and builds one himself. This is accomplished by banking up the sand with the snout until it forms a rampart round an empty shell. The sand beneath the shell is then dug out until a deep and well-protected basin is formed. Within this the female lays her eggs, which are duly aerated by a constant fanning on the part of the male's fins. Although not endowed with any special armour, the father displays reckless courage in the defence of his young.

With the exception of the Giant Goby, *Gobius capito*, which is found at rare intervals off the coast of Cornwall and may attain a length of 10 inches,

[Photograph by Central News.

WOLF FISH

Facing p. 115.



the eight British species of goby are all quite diminutive fishes rarely exceeding half a foot in length.

The Black Goby, *Gobius niger*, should commend itself to the aquarist since it can be gradually acclimatized to fresh-water. This power of adaptability is developed in a tropical goby known as the Mud Skipper, *Periophthalmus koelreuteri*, which has the pectoral fins developed into regular limbs and not only spends long periods perambulating the dry land, but even climbs trees and bushes, where it varies its normal diet of shrimps and baby crabs with a tasty snack of butterfly or mosquito.

The Blennies are essentially rock-haunting fishes, very abundant in both hemispheres, and occurring at all depths. Some are confined to the abyssal depths, whilst others are purely coastal and spend all their time in quite shallow water. Four species are found in our rock pools and may be kept successfully in the aquarium.

The Wolf Fish, *Anarrhicas lupus*, is the giant of the group, attaining an extreme length of 6 feet. It is a northern fish abounding in Icelandic waters, but rarely found south of Lowestoft. Some of us have eaten this most repulsive-looking fish under the aristocratic name of "rock salmon" by which it is described in the trade. Owing to its forbidding appearance it is never exposed on the fishmonger's slab in an intact condition, but headless and ready skinned. Few fishes have a more powerful dentition, for with its teeth it

can break up the largest of whelk shells, and make short work of a full-sized lobster or even crab. Like all blennies, it is very pugnacious and has been known to attack persons wading at low-tide.

The Common Blenny or Shanny, *Blennius pholis*, is a miniature edition of the Wolf Fish ; and although seldom attaining a length of more than 6 inches is even



THE WOLF FISH.

more aggressive than its huge northern relative. It bites with extraordinary viciousness when handled, and in the aquarium is sometimes apt to be a nuisance. It bites at everything it sees—the gill-plumes of worms, the eye-stalks of crabs, the antennæ of prawns, and the tentacles of molluscs and anemones. Normally it feeds principally upon acorn-barnacles, nibbling their

hard, sharp-edged shells from off the rocks. It enjoys the sparrow's perky temperament, and insinuates itself into all sorts of retreats such as holes in the top of harbour piles, or crevices high up in the rocks that may remain uncovered at low-tide. In such situations it may be stranded high and dry for several hours at a stretch without apparently experiencing the slightest inconvenience. Indeed, it will often leave its hole and deliberately crawl about upon the rocks. Although a born bully it is a good parent, and in May and June keeps ceaseless vigil over its eggs which are deposited in layers on the underside of some overhanging boulder.

The Tom-pot Blenny, *Blennius gattorugine*, is largest of the blennies, and is rendered conspicuous by a pink fringed tentacle, like a little cockscomb, situated over each eye.

The most striking member of the genus is the Butterfly Blenny, *Blennius ocellaris*, in which the very large dorsal fin is decorated with a large black eye-spot surrounded by a white ring. Its eggs are usually deposited in whelk shells, in which the male takes up his quarters as soon as they are laid. When thus mounting guard, the little fish looks like a sort of maritime bulldog ensconced within its kennel.

The Butterfish or Gunnel, *Pholis gunnellus*, is a small blenny that has become so elongated as to suggest an eel which it fully equals as regards slipperiness. The name "nine-eyes," by which it is sometimes known,

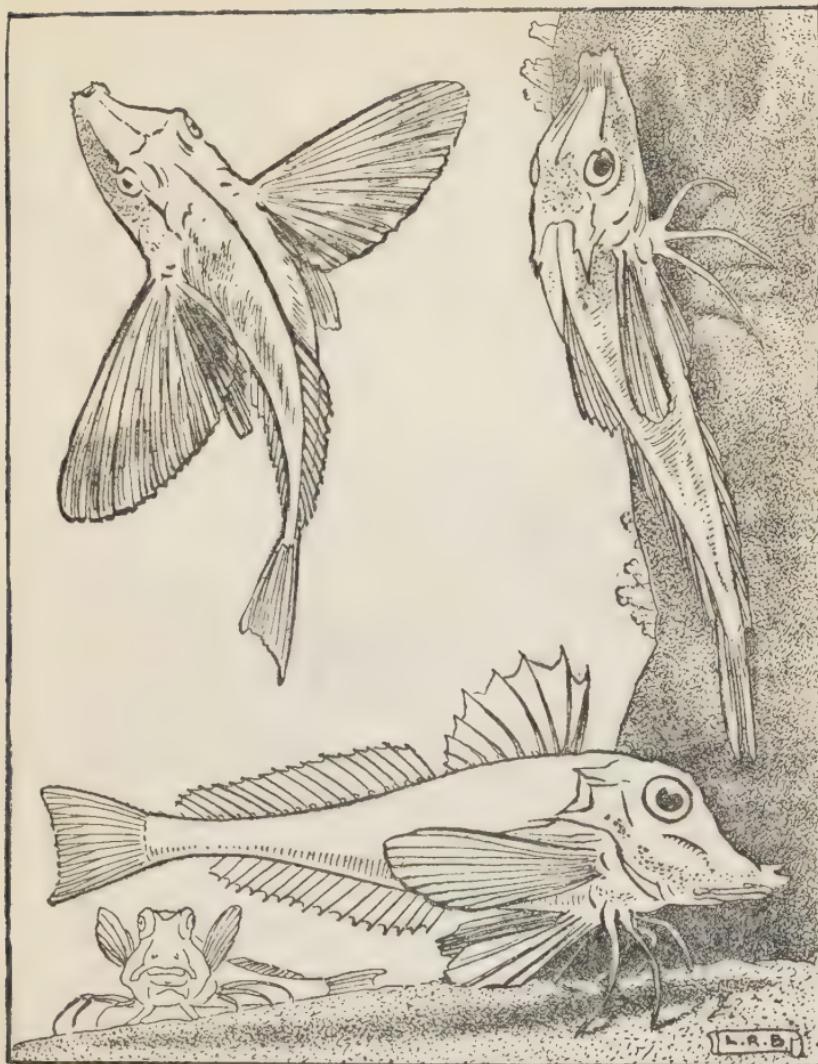
is derived from the row of eye-spots ornamenting the dorsal fin. Like the true blennies, it is commonly found under stones, but is not adapted for "rock hopping," having a deeply compressed body and very small pectoral fins. Whereas in the majority of fishes which take special care of their eggs or offspring, it is upon the male that the family cares chiefly devolve, in



BUTTERFLY BLENNY.

the butterfish it is in the female that the nursing instinct is developed, and the eggs which form a globular mass are incubated by the mother coiling her body around them.

The Gurnards, which have aptly been described as the butterflies of the sea, have huge pectoral fins resembling the wings of a butterfly, and the resemblance is



GURNARDS.

rendered the more obvious in the breeding season when they glow with a vivid metallic lustre. Their large conical heads are more or less completely armoured

with limy plates which may extend to the body. Another striking peculiarity is the development of the breast fins, which have the first three rays free. These rays can be used like the legs of a crab for walking about, and in the aquarium the fish may be observed crawling over the sand or even rocks in a manner suggestive of a crustacean. All are capable of emitting grunting sounds when taken from the water, the sounds being caused by a sudden contraction of the air-bladder.

The Sapphirine Gurnard, *Trigla hirundo*, is the largest species, sometimes measuring 2 feet in length, and weighing 14 lb. The brilliant tints of its enormous pectoral fins make a most beautiful display in the aquarium in which it may thrive for a considerable period.

The Bullheads include a number of small inshore fishes with large heavily armoured heads and big fan-shaped breast fins. They rely for safety, however, chiefly upon mimicking their surroundings, and the visitor gazing into their tank at the Zoo, which contains nearly a hundred specimens, will sometimes have difficulty in detecting their presence.

The Common Bullhead, *Cottus bubalis*, which abounds on rocky shores, lays its eggs in circular masses on the underside of stones. They are protected by both parents who aerate the water surrounding them by fanning with their large fins. The young fish when they hatch are very small, and their tiny glassy

bodies display the internal organs in action with the greatest clarity.

The Pogge or Armed Bullhead, *Agonus cataphractus*, has a quaintly shaped angular head and a perfect beard formed of barbules.

The Dragonet, *Callionymus lyra*, a brilliantly coloured fish suggesting the gurnard in shape, is fairly



DRAGONET.

common on sandy shores, harmonizing perfectly with the sand wherein it hunts for the small molluscs and worms upon which it lives. During the breeding season it sparkles with flecks of vivid gold, blue, green, and lilac. In the male—a much larger fish than the female—these patches of colour may be enlarged until they meet, assuming vivid bars. Its eye is a veritable

jewel, whilst the first dorsal fin is developed into a huge crest nearly as large as the remainder of the fish.

The Marine or Fifteen-spined Stickleback, *Spinachia vulgaris*, the only stickleback that is entirely marine, is an elongated golden-brown fish measuring up to 6 inches in length. It is popular amongst those that keep marine aquaria for the reason that not only is it a very graceful creature thriving for many months in captivity, but also because it is a scavenger and can be introduced into tanks with less greedy inhabitants of the ocean, in which it will clear up all the rejected food. It makes curious nests, which are the work of the male fish only. The nest measures 6 to 8 inches in length, and is composed of seaweed interwoven by threads secreted by the kidneys. On its completion the male entices the female to enter to deposit her eggs, using every possible device to induce her to do so. In the frequent event of his invitation not being accepted he will eventually resort to force, and, seizing his "intended" by the fins or tail, drag her after him into the nest. The eggs having been laid, the mother departs and the father keeps a vigilant guard over them and the young after they are hatched, defending the nest and its contents with great ferocity from the attacks of other fish.

The Angler, *Lophius piscatorius*, is an interesting fish rarely seen in the aquarium. Specimens have, however, lived for short periods in London, Plymouth, Naples, and New York. The angler-family is a large

one distributed throughout all seas, cold as well as warm, deep as well as shallow. All lure their prey into their mouths by means of a number of fishing-rods evolved from the first few spines of the dorsal fin, which carry baits in the form of flaps of skin ; and by wriggling these entice the small fishes upon which they live. The prey once within reach, the cavernous mouth is opened and the sudden inrush of water carries the victim into the interior. Although brought to market in vast quantities, owing to its unprepossessing appearance, the angler, like the wolf fish, is seldom seen in its entirety by the public. No creature is better endowed to make the most of its environment. The angler being a bottom-feeder, his eyes, like those of the skate's and turbot's, are set on the top of his head. The sides of the body are beset with a vast number of skinny appendages, perfectly resembling fronds of weed, thus rendering the fish all but invisible, and so fulfilling one of Sir Isaac Walton's golden rules, namely that the successful angler must as far as possible practise the "gentle art" of concealment. The angler digests its food very slowly and the longshore fisherman often does not scruple to transfer fish from its stomach to his stall or counter.

In the ocean abyss, where all is wrapt in impenetrable darkness, the "lures" of the anglers that inhabit those waters are developed into luminous organs. One species of angler is remarkable for the disparity in the size of the sexes, the tiny male appearing to be a mere

parasite when clinging to his bulky bride. Not only is he carried about by her, but eventually becomes grafted to her, deriving nourishment from her blood-vessels.

The adult angler, which is generally regarded as a lumpish brute, commences life upon the waves' crest as a veritable butterfly. It is hatched from one of half a million eggs, the spawn covering one-tenth of an acre of water. The young fish soon acquire the swollen head of its parents, and the graceful fins degenerate into stumpy limbs only capable of dragging the angler over the sea-floor where he relies upon concealment and cunning for a livelihood.

The Cling or Sucker-Fishes, *Lepadogaster*, are all of small size and feeble movement. They are common around our coasts, where they lurk beneath stones, securely anchoring themselves by the powerful oval-shaped suckers formed by a fusion of the breast fins. These little fish are pinkish in colour and usually bear two dark-blue spots on the sides of the body. The sucker lays its eggs under stones or within shells, where they are guarded—as is usual in fish society—by the male.

It is possible to keep a number of tropical marine fish in the aquarium. The difficulties of importing them are, however, sufficiently great to give the aquarist cause for congratulation upon every specimen that he is able to transfer from lagoon or coral reef to the tanks of a northern aquarium. The water in the travelling tanks which must be kept at the right tem-

perature has to be aerated and kept in constant circulation throughout a long voyage, if success is to be achieved. Naturally only a few species, and those mostly of moderate size, are at present shown in our aquarium where they are exhibited among a realistic setting of shells, sponges, and corals. Against the dead coral branches of their tank the fish are more conspicuous than they would be in a state of nature where in the sun-drenched waters of the coral reef their glowing tints are less obtrusive, and more protective.

A fairly hardy and very beautiful Coral Fish is *Amphiprion percula*, which hails from the East Indies. It is of a vivid orange ground-colour barred with broad light-blue bands, whilst the bands and fin-margins are edged with black. The scenic effect of a shoal of these fishes swimming against a background of blue-green water must be seen to be fully appreciated.

This coral fish, being unarmed and of a timid disposition in its native waters, elects to spend most of its time within the cavity of a giant anemone, *Discosoma*,—a gaudy coelenterate measuring over 4 feet in diameter—and a stick or other weapon thrust into the mouth of the anemone invariably causes one or more of these fish to emerge in a nervous flutter. The most extraordinary feature of this strange combine lies in the fact that the anemone apparently lives solely upon the excrement of the coral fishes. There is an opposing theory, some authorities asserting that the specially vivid colours of these fish attract other

fish within the range of the anemones' stinging cells. Post-mortems on the anemones have, however, revealed no other forms of nourishment than the waste products of their guests. No net or hook is required to capture these fishes for the aquarium. A native diver is employed. He swims to the sea-bed and just grabs a handful of anemones in each of which a coral fish is enclosed ! Normally the fish live upon minute crustacea, molluscs, etc. At the Zoo they thrive upon a diet of chopped mussels, previously boiled to sterilize any harmful bacteria that may be present, horse's heart, *Daphnia*, blood worms, etc.

Another Coral Fish, *Dascyllus aruanus*, which is exhibited in the aquarium is jet-black in colour, marked with broad white bands which encircle its face in the manner of a bandage.

The Argus Fish, *Scatophagus argus*, of Eastern Asia, which owes its name to the staring "eye-spots" that emblazon its gold and green sides, is a scavenger haunting the mouths of rivers. It is equally at home in fresh as in salt water. Specimens living in the Zoo aquarium grew from a length of 2 inches to 5 inches in the course of only six months.

The family of Ball, Puffer or Globe Fishes, *Tetraodontidæ*, is represented in most tropical or semi-tropical seas and estuaries. The outstanding feature of these sometimes elongated fishes is their power of inflation which is achieved by the distention of their interior with either air or water, when they become globular

in shape. In some the skin is fairly smooth, whilst in others it is covered with a mass of erectile spines. When inflated with air these fish float on their backs and drift with the tide, those endowed with spines being perfectly safe from attack. When returning to their normal condition the fish expels the air through the mouth and gill-opening with such force that a loud hissing noise is produced, audible at a considerable distance. The members of this strange family which do well in the aquarium, becoming very tame, are further remarkable in that the front teeth are modified into large cutting plates and by means of them are able to browse upon the living corals, barnacles, and bivalves upon which they exist.

The Puffers are of little economic value, although commanding a certain popularity as curios, as their flesh is highly poisonous. Some of the larger forms are used as footballs by youthful sportsmen in certain parts of the Far East.

CHAPTER III

REPTILES

MILLIONS of years ago the world was ruled by reptiles. They dominated the land and monopolized the seas in which they attained their maximum development. To-day the largest living reptile is but a pygmy when compared with the giant prehistoric forms which are known by their skeletons and footprints.

In this chapter we shall deal only with such purely aquatic reptiles that may be exhibited with success in the aquarium. The list is a short one, including only one member of the crocodile family, the sea-snakes, and the turtles.

The crocodile in question is the olive-brown Marine Crocodile, *Crocodilus porosus*,—a man-eater—which attains a length of over 20 feet and a weight of nearly a ton. It infests the whole of the Indo-Pacific region and unlike all other crocodiles and alligators only completely leaves the water in order to lay its eggs. The family cares having been cast aside, it is once more free to roam the oceans, and only returns to “terra firma” the following year in order to bring yet another batch of youngsters into the world. Whilst some crocodiles

and most alligators become tolerably tractable in captivity, the marine crocodile remains constantly savage and aggressive. It makes a striking aquarium exhibit, especially at feeding time, when it falls upon its food with incredible ferocity, tearing it to pieces with violent contortions of the body.

The Sea-Snakes, which are very abundant in all the tropical seas of the Eastern Hemisphere, are rarely shown in captivity owing to their delicate constitutions, and the difficulty of transporting them long distances in the living state. Two fine specimens of the species *Enhydrina valakadien* are at the time of writing thriving in the Zoo aquarium. These serpents, which are very poisonous, but not at all aggressive, are so perfectly adapted to an aquatic life that they never attempt to come ashore. The body of a sea-snake is much compressed, especially the tail, which is paddle shaped and forms a fin-like appendage of great service in swimming, forcing the creature through the water at a great pace. The end of the body is prehensile, and is employed by the reptile not only to anchor itself securely to weeds, corals, etc., but also to hold its victim until the poison injected has had time to take effect. The nostrils are valvular and are situated on the top of the head. The colour scheme is similar in most sea-snakes, taking the form of bands of olive or black and yellow, a ringed pattern which is protective like that of a tiger or zebra, the bands helping to break up the contour of the body of the snake as it

lies amongst fronds of seaweed in wait for its prey.

These sea-snakes have many enemies, and are devoured with impunity by sharks and sea-birds, the latter having been observed to take the snakes to the mast-head of a passing vessel, and there beat the reptiles to death with feet and wings, following the tactics of the Secretary Bird.

The reptiles that are most attractive in the aquarium are the marine turtles which at the Zoo are represented by the Green Turtle, *Chelonia mydas*, the turtle inseparable from the civic banquet, the Logger-head Turtle, *Thalassochelys caretta*, which is likewise edible, and the Hawksbill Turtle, *Chelonia imbricata*, from which the tortoise-shell of commerce is obtained. All do well in the marine aquarium provided they are kept at a fairly high temperature (70° F. to 80° F.) and provided with plenty of lettuce and fish. These and all the true marine turtles are entirely aquatic, never venturing ashore save for the purpose of egg-laying. The eggs, which resemble ping-pong balls in size and shape, are buried in the sand, where they are left to their fate. In the course of about four months the little turtles emerge and under cover of night scuttle down to the sea. If they successfully run the gauntlet of the monkeys, racoons, and various large birds awaiting them, they launch themselves upon the waves, where they risk the attack of a host of marine animals. It will be appreciated that the casualty list is a heavy one, and it has in fact



THE TURTLE TANK.

Facing p. 130.]



been calculated that out of a normal clutch of 120 eggs only two or three turtles attain maturity.

In the aquarium turtles are seen at their very best. There, amid a background of corals and tropical shells, these lumpish monsters positively "flit" through the water with a movement of their huge flippers far more suggestive of flight than of swimming. The swallow may be swifter, but is certainly not more graceful than a turtle in his native element. Turtles are captured for market—and aquarium—in various ways. They may be caught when coming ashore to lay their eggs, netted, or harpooned. In the West Indies two very remarkable, and at the same time picturesque methods of capture are in vogue. The first consists of a highly skilled negro-fisherman leaping from the collecting vessel and grappling with the turtle in the water. By sheer skill, strength and daring he brings the turtle to within easy reach of the ship, where it is hauled on board. The second method is a still stranger one, as it relies upon the fish known as the "shark sucker" for success. The fish is held in leash by a long line and cast adrift in a locality known to be inhabited by the turtles. It soon selects one, and attaches itself to it with extraordinary tenacity by its large sucking disc, which is situated on the upper surface of the body. It is then, along with the turtle, heaved on board.

The term to "turn turtle" is a simile for helplessness, but curiously enough the best way of keeping a turtle alive for any length of time out of water is to turn it on

its back. A glance at the creature's anatomy will make the reason clear. The under-shell is so soft compared with the upper portion that if the turtle's great weight were imposed upon it for long, the internal organs would suffer such compression that death would speedily ensue. In a great body of water, of course, the "dead weight" is at once relieved, and the aquarium turtles may often be seen resting on the tank floor with their fore-flippers crossed upon the breast in a ludicrously human fashion. This and other characteristic poses are suggested in the illustration.

The brain of a turtle is feebly developed, and would appear to be of small consequence. The following story, however, seems to prove that the turtle's brain is at least capable of connecting cause with effect. Some years ago the Amsterdam aquarium authorities were faced with the position of having more specimens available than they could conveniently accommodate,—a state of affairs at once trying as well as gratifying. The cause of the dilemma was the unexpected arrival of a large consignment of mullet. It was finally decided to "chance them" with a number of turtles. To ensure the mullet at least an hour or two of life they were introduced to the turtles a few at a time, the water being violently agitated the while, thus diverting the turtles' attention from the immediate prospects of a meal. As was the intention, the turtles apparently associated the mullet with the uproar and splashing, and regarded them with awe. At any rate they left

them severely alone, although they shortly afterwards devoured other fish placed in their tank for the purpose. The mullet remained unmolested in the same aquarium with the turtles for some months, although any new mullet introduced were eaten. At a later date, however, it was found possible to give the fish a tank to themselves. The effect upon the turtles was at once apparent. Deprived of their tank-mates they refused to feed,—moped in fact—until their health became a matter of grave concern. The choicest foods failed to revive their former gaiety. In desperation the mullet were reintroduced, and from that time onwards there was no happier tank of turtles ever shown to the public.

PART II

THE FRESH-WATER AQUARIUM

CHAPTER I

INVERTEBRATES

THE invertebrate animals of our fresh waters, although less in evidence than their marine relatives, are sufficiently numerous, both in number of species and individuals, to "people" every pond and river with a wealth of life. Every stagnant pool is a miniature ocean ; every patch of scum or weed a Lilliputian jungle. The majority of the principal groups of marine invertebrates have numerous representatives in pond or stream, and their numbers are augmented by a host of insects which spend their larval period under water. To enumerate all or nearly all the lower forms of pond life within the compass of a single chapter, or even volume, is obviously impossible. The enthusiast will find the life-cycle of any of them sufficiently intriguing to beguile all his leisure hours, —and more. The average amateur aquarist will value the smaller fresh-water invertebrates chiefly in accordance with the manner in which they minister towards the well-being, or otherwise, of his fish. For the guidance of such this chapter has been compiled.

Whilst the various algæ that appear in the tank must always be kept in check lest they get the uppermost of

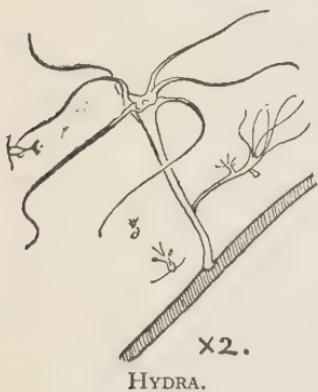
the more valuable plants, they nevertheless have their merits, since they harbour a wealth of minute life, animal as well as vegetable, which is indispensable to young fish.

Our only fresh-water Sponge, *Spongilla fluviatilis*, covers the banks of the Thames and other rivers, and is specially plentiful on the timber-work of locks. It increases, as explained when dealing with the marine species, by continual budding ; forming large branches

of vivid green colour. These branches may be artificially divided up, when each portion will form the nucleus of a separate clump. Conversely, small portions planted close together may unite to form a single mass. Much aeration is needed to keep the fresh-water sponge in a thriving condition,

as the water continually circulates through the small apertures of the sponge and escapes through larger ones which are situated on the summit of conical projections.

The principal fresh-water polyp is the Hydra, which is known in this country by three species that differ from each other chiefly in colour and the number of tentacles. This diminutive relative of the sea-anemones is named after the many-headed monster slain by Hercules, owing to the fact that if a hydra bud is separ-



ated from the parent stock others quickly take its place, whilst the severed bud itself will give rise to others. The creature further reproduces by the dissemination of spores, so that it multiplies with extraordinary rapidity. The hydra's body is long and slender and surrounded by six or more tentacles that spread out in all directions. As in the case of the anemones, if molested the tentacles withdraw within the main structure of the body which shrinks into a rounded insignificant mass. In the aquarium the hydra should be isolated, for owing to their carnivorous habits and great fecundity, they are a menace to newly-born fish and other small inhabitants of the tanks.

The most conspicuous of our fresh-water worms are the leeches. They are abundant in stagnant as well as running water. One kind, the Medicinal Leech, *Hirudo medicinalis*, which attains a length of over 6 inches, is farmed on the Continent. Although no longer cultivated in England, it is still imported and used by the "profession" in this country in greater numbers than is generally supposed. The body of a leech is soft and elongated, and, like that of a typical worm, composed of numerous segments. At the foremost extremity is a large circular disc in which is situated the mouth by means of which it can firmly attach itself to inanimate and living objects. Leeches, before sucking the blood from the bodies of their prey from which they derive their nourishment, first inflict a wound with the sharp saw-like teeth with which their mouths

are provided. They are first-class swimmers, progressing through the water by flattening their bodies and contracting the muscles, when they assume a flat ribbon-like shape.

The medicinal leech is a quite handsome creature and makes an attractive aquarium exhibit. It is dark green in colour with six orange bands along the back. A large specimen is capable of consuming $\frac{1}{2}$ oz. of blood at a single meal, after which it will swell to more than double its normal size.

Allied to the aquatic worms are the microscopic Rotifers or Wheel Animacules, so called because of the incessant motion of the numerous hairs situated on the lobes of the front end of the body which present the appearance of a revolving wheel. These lashing hairs produce currents of water which sweep the food particles into the mouth.

The head end of the body of these transparent creatures is often much broader than the opposite extremity which is usually anchored to foreign bodies of different kinds. Female rotifers are much more numerous than males. They have a complicated digestive system, including a gizzard in which the food is crushed, whilst in the males there is no digestive tube.

Some rotifers can be kept dry for comparatively long periods, and will resume activity whenever they come in contact with water.

The small fresh-water crustaceans are amongst the aquarist's greatest assets. The so-called "Water flea,"

Daphnia pulex, swarms in most ponds and ditches during the summer months, and is sometimes so abundant that the water is tinged a rusty red,—the colour of its transparent body. No chance to collect these little crustaceans should be missed, since they form the best of all food for small fish, and are easily cultivated. The “farm,” which needless to say is best kept out of doors, can consist of a large tub or bath well carpeted with mud, rotten leaves, and other decaying matter. The tank should, of course, not be allowed to become over-crowded, as the creatures take up the oxygen of the water as do other aquatic animals. The bivalvular carapace of *Daphnia*, which is so transparent that the whole of the internal organs are distinctly visible, somewhat resembles the shell of certain bivalve molluscs, and terminates in a prominent beak. *Daphnia* has four to six “gill” feet, large branched antennæ which act as organs of locomotion, and very strong jaws, armed with spines.

The female “water-flea” is more than double the size of the male, which it outnumbers by about a million to one. The eggs are retained within the female and



THE SO-CALLED “WATER FLEA” (*Daphnia pulex*).

the young are almost perfectly formed when they emerge.

The Cyclops, or to give it its full name *Cyclops quadricornis*, is another common fresh-water crustacean, so called because it has but a single eye like the giants of Greek mythology that gave Ulysses so much trouble. Like its larger relative, *Daphnia*, which it resembles in many respects, it is greatly appreciated by all fish, specially young ones. The female is a conspicuous object when carrying her eggs, which are packed in two pear-shaped sacs, one on each side of the body.

The Fresh-water Shrimp, *Gammarus pulex*, greatly resembles the common sand-hopper in appearance. It is very abundant in many rivers and streams and is highly appreciated by most fish, especially salmon, trout and char. It feeds on decaying matter, both animal and vegetable, and is a useful creature in the aquarium, as apart from providing food for the more valuable exhibits, it acts the part of a scavenger.

The Crayfish, *Astacus fluviatilis*, an inhabitant of clear gravel-bedded streams, well deserves a tank to itself, as it is a miniature lobster possessing all the entertaining habits of that popular crustacean. It is well to keep but a single pair in the same tank, thus eliminating all serious strife. Comfortably housed in a three-gallon tank, they will require no other "furniture" than some clean river sand or gravel, and a number of small flower-pots laid upon their sides in which they will spend most of the daylight hours.

Their tank should be a shallow one, not more than 6 inches in depth—and the water should be kept in constant circulation. Crayfish will eat almost anything, and all being well will periodically present the opportunity of observing that wonderful phenomenon—the casting of the shell. The tank must be kept covered, since its inmates are given to wandering, and unless restrained may cause embarrassment by appearing where and when not wanted.

Spiders possess characteristics in common with certain crustaceans. One of our native spiders, *Argyroneta aquatica*, is purely aquatic, and although an air-breather like its web-spinning brethren of the garden, elects to spend its life under water. The air-breathing is made possible by the fact that the creature is covered all over with fine waterproof hairs which hold the air in suspension until absorbed. It can remain below the water for hours on end, where it works assiduously at the construction of a soft, silky, cup-shaped cocoon having an opening on its underside. Into this opening air bubbles are introduced, each bubble being brought separately from the surface and placed into the sac until it is completely inflated. Within this miniature diving-bell the spider lives, dining upon such small animals that it can capture. The family is reared in this cocoon, in a second, and entirely separate chamber, constructed by the female, and placed by her within the main structure.

The Insects which spend some parts of their exist-

ence under water number many hundreds of species. The gnats that spoil our night's repose, the great flying-beetles that dash into the lamp, the caddis and mayflies that supply the fisherman with bait, the gaudy dragon-fly that delights us on a midsummer's day,—these and many more can be reared in an aquarium of even the jam-jar variety. Great caution must be exercised in associating the various insect larvæ with fish,—or even each other. All the vegetable-feeding forms may be safely introduced with fish too small to engulf them. The carnivorous species must be isolated, or trouble will ensue.

Dragon-fly larvæ, if given private apartments, and are sufficiently well fed to prevent them becoming cannibals, will in due season emerge as perfect insects. In nature they live at the bottom of ponds, patiently waiting to pounce upon and devour any animal they are capable of overpowering. When about to attack they uncoil a strange weapon which covers the front of the head and represents the lower lip. This animated mask when fully protruded exceeds the length of the body. It is armed with a pair of pincers and acts not only as a lip, but also as an arm to seize its prey.

Their tank should be supplied with plant stems rising well above the surface. The pupæ will climb up them on reaching maturity and there make the last great change—one of the most fascinating spectacles the aquarium has to offer.

The larvæ of the Caddis flies are eminently suited

to small aquaria. The insects spend their "caterpillarhood" at the bottom of ponds or streams, where most forms construct tubular houses from shells, gravel, sticks, etc., wherein to conceal their soft and defenceless bodies. They will, if provided with coloured beads or sequins, use such material with novel and ornate effects. The instinct of orientation in these larvæ is very remarkable and they will nearly always return to their own homes if expelled, even when replaced in the midst of a large number of empty cases of similar appearance. The eggs of the caddis fly are hatched during the summer months, and the immature insects remain in the larval stage until the following spring or summer.

The scarlet worm-like larvæ of the midges of the genus *Chironomus* are to be found in the mud or decomposing vegetation of most ponds. Commonly referred to as "blood worms," these creatures are highly esteemed as food by a large number of fishes.

Special care should be taken to restrain water beetles as they are nearly all night-flyers, and may not come home to roost, but at dawn resort to another aquarium containing fish.

The powerful carnivorous Tiger Beetle, *Dytiscus marginalis*, will attack creatures several times its own size. Its upper surface is dark brown in colour, whilst the thorax is bordered with yellow. The larva has an elongated segmented body tapering at the tail, which terminates in a pair of fringed appendages. The head,

which is large and roundish and furnished with a pair of long slender jaws, is joined to the thorax by a narrow neck.

The Great Beetle, *Hydrophilus piceus*, which is our largest native water beetle, attains a length of an inch and a half. As it is a vegetarian it may be kept in the same aquarium with fish. From the Tiger Beetle, which it superficially resembles, it may be distinguished by its larger size and shorter mandibles and antennæ. The body is brown or olive above, but appears silvery



CARNIVOROUS WATER BEETLES.

Water Scorpion.

Boatman.

Tiger Beetle.

Larva of
Tiger Beetle.

Pupa of
Dragon-fly.

below, the silver colour being due to a layer of air particles which remains attached to the downy hair of the beetle's undersurface. The female is provided with a spinning apparatus, situated at the extremity of the abdomen, by means of which she spins a cocoon on the surface of the water, attached to the stem of some aquatic plant, and in this receptacle she lays her eggs. The larva of *Hydrophilus* is somewhat shorter and more bulky than that of *Dytiscus*.

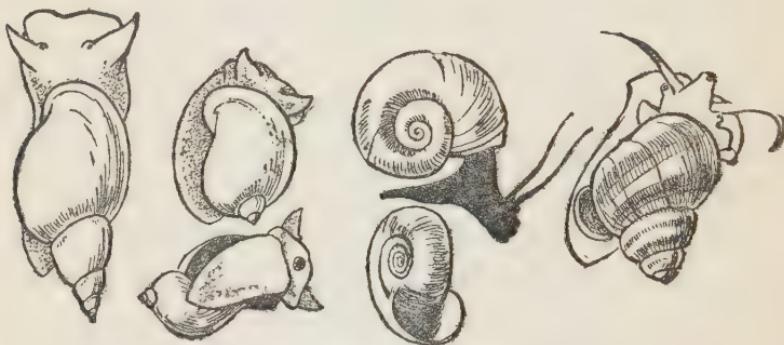
The Water Boatmen, represented by several species,

are extremely abundant in all ponds and may be observed during the summer months swimming on their backs, just below the surface of the water. They are admirably adapted to aquatic life, for their stout bodies are shaped like inverted boats and their flattened hind limbs are fringed with hairs that stand out in the position of oars. They have a strong beak with which they can inflict quite painful wounds to the human hand and kill almost any small aquatic animal. The air supply of the boatman is carried in its wings, and it therefore has to return to the surface for replenishment at frequent intervals. The larvæ resemble the perfect insects, but have no wings.

Some remarkable if somewhat gruesome experiments have in recent years been conducted in the aquarium of the Biological Experimental Institute in Vienna, where the decapitated heads of living water beetles have been successfully transplanted to the bodies of other insects. The author himself had the privilege, when visiting Vienna some years ago, of seeing an aquarium in which beetles with *Dytiscus* bodies and *Hydrophilus* heads were actively swimming about and diving under water. The heads were cut off with a pair of sharp scissors and merely cemented to the bodies with the exuding fluid, no suture being required. According to the officials at the Institute, the insects so operated on are controlled by their new heads and not by their bodies. Female beetles provided with male heads were said to develop male

instincts and to court normal females, whilst males with new female heads were stated to become passive.

Similar experiments were conducted on two species of boatmen beetles, *Notonecta glauca*, which is uniform brown in colour, and *Notonecta marmorata*, which is brown with black reticulations. When the head of the latter was transplanted on to the body of the former it assumed, within a few weeks, a marbled pattern.



USEFUL AQUARIUM SNAILS.

Limnaea stagnalis. *Limnaea pereger.* *Planorbis corneus.* *Paludina vivipara.*

The Molluscs are well represented in fresh-water. Two species, the Fresh-water Limpet, *Ancylus fluviatilis*, and the Nerite, *Neritina fluviatilis*, are inhabitants of fast-running streams and will seldom thrive for long in the average aquarium. Nearly all other kinds, however, do well and are often indispensable to a correct "balance." The univalves figured are good scavengers, addicted to clearing up refuse of all kinds, and keeping the glass clean. The gelatinous egg-masses which are lavishly deposited on the plants during the summer months, apart from affording an

interesting subject for the microscope, are welcomed as food by all manner of fish.

The bivalves such as the Swan Mussel, *Anodonta cygnea*, perform several useful offices in the aquarium. They feed by inhaling water through one of two siphon pipes extracting the organic matter contained, and expelling the purged water by the "exit" tube. Thus they act as filters, and assist in the general circulation of the water. By ploughing up the sand with their big foot and wedge-shaped shell they also help to keep the bottom fresh, dislodging decaying matter that may have become partially buried. Several of our native fresh-water mussels produce pearls,—of a kind—whilst the Painter's Mussel, *Unio pictorum*, is remarkable in that it acts as a nursery for the young of a certain carp.

The life-histories of our native fresh-water invertebrates have engaged the attention of many professed scientists throughout the past century.

A small and unpretentious beginning, no farther away from home than the nearest reservoir or water trough, may well lead the amateur on to make further incursions into the wonders of the water world, which will reveal to him a wealth of romance and beauty hitherto unsuspected.

CHAPTER II

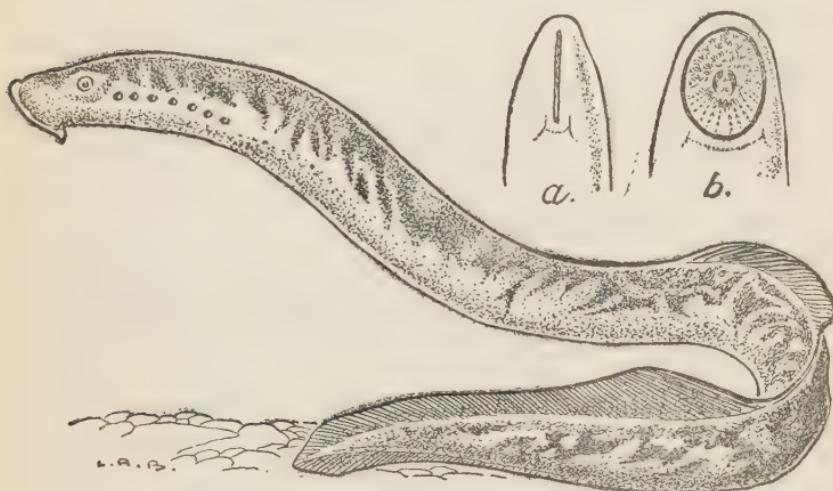
FISHES

OUT of the many hundreds of species of fresh-water fishes, only a quite insignificant number have been kept in aquaria. The cold-water forms are naturally better known than those emanating from tropical streams and rivers, but in spite of the difficulties and dangers attending the collection and safe transport of the latter, quite a number have been kept in captivity and acclimatized in this country. To show the tropical fish in anything approaching natural surroundings is obviously impossible, and the visitor to the aquarium must exercise his imagination and picture the majority of the brilliantly coloured forms which he sees on exhibition as living in fever-haunted swamps and crocodile-infested rivers at which troops of antelope, monkeys, deer, and elephants take their evening fill.

In this chapter we shall review the many wonderful fishes inhabiting our own rivers, as well as those living in tropical waters, dwelling upon such as may be seen at the Zoo aquarium.

In captivity the tropical forms will thrive in water at a temperature of about 75° F.

The Lamprey, *Petromyzon fluviatilis*, is a creature firmly imprinted upon our memories as the fish that caused the death of King Henry II. As a matter of fact, lampreys are "not quite" fish, from which they differ in having no transverse jaws, the mouth being circular and suctorial, and no paired fins. Further, they are provided with a peculiar type of breathing



LAMPREY (*Petromyzon fluviatilis*).

(a) Mouth closed. (b) Mouth open.

apparatus, no scales, and a soft cartilaginous backbone. The suctorial mouths, by means of which they attach themselves to other fish, are lined with concentric rows of sharp cutting teeth, and by means of these rasp away the skin and flesh of their prey. From February to May, according to climatic conditions, the lampreys ascend our rivers in vast shoals, and selecting a gravelly site turn to nest building. This is accomplished by

removing large stones from the river-bed in their succatorial mouths until a large trough is formed, and in this receptacle the eggs are laid. The eggs are connected together by sticky threads which collect the sand and grit, at once anchoring and concealing the spawn. The young have at first no visible eyes or mouths. In four years they reach maturity, when they propagate,—and die, so great are the labours involved by the nest building and egg laying. In the aquarium lampreys spend much of their time concealed in the sand, but they are also given to attaching themselves to the glass front of their tank, where their peculiar mouths may be seen and studied to perfection.

The primitive fishes such as the Lung-Fish, the Snake Fish, the Sturgeon, and the Bow-Fins, are amongst the most interesting of the exhibits in the large public aquarium. They swim to-day before a crowd of sightseers as once they swam, with none to observe them save the prehistoric animals which have been non-existent for millions of years.

The Lung-Fishes at one time enjoyed an almost world-wide distribution, but are now confined to the fresh waters of Australia, Africa, and South America.

The largest is the 6-foot-long Australian Lung-Fish, *Ceratodus forsteri*, of which two specimens have for many years been on exhibition at the London Zoo. The air-bladder of the creature is modified to do duty as a lung, a truly beneficent dispensation since the fish lives in the stagnant pools of the Mary River in Queens-

land, where the water in the hot weather becomes foul and unfit for breathing by means of gills. Its movements are very deliberate and in its structure and general behaviour suggests a salamander or huge newt rather than a fish. For long periods it will rest motionless at the bottom of its tank with uplifted head, the body raised upon the bases of its large paddle-



AUSTRALIAN LUNG-FISH.

shaped breast fins. At other times, this lung-fish will slowly swim about the aquarium. After having risen to the surface to fill its lungs with air, a procedure which takes place at intervals of about half an hour, it slowly sinks to the bottom again, its extended fins acting as parachutes. Sometimes when resting on the floor of the aquarium it will rock from side to side in a way which suggests the well-known habit of the giant

aquatic salamanders. The Australian Lung-Fish feeds on both animal and vegetable matter.

The African and South American lung-fishes are not unlike in general appearance, but the body differs in being more eel-shaped and the fins in assuming the form of long worm-like filaments that are quite useless for swimming purposes. Unlike the Australian Lung-Fish which never leaves the water, both the African, *Protopterus*, and South American, *Lepidosiren*, live entirely out of that element for several months in the year. On the approach of the dry season they burrow some 18 inches into the mud, in which they construct a cocoon lined with a slimy mucus secreted by certain glands. In this chamber, which is connected with the surface by a narrow tube, the fish lie comfortably coiled up throughout the longest drought. Several specimens of the African Lung-Fish, now living in the Zoo aquarium, arrived in the dry state, and the large lumps of sun-baked earth containing the cocoons had to be soaked in tepid water for some hours before it was found possible to release them. In these lung-fish the paternal instinct is very highly developed. In the African the father not only constructs the nest, which takes the form of a large circular hole excavated in the bottom of a pool, but also mounts guard over the eggs when they are laid, aerating them by violently lashing the water with his tail. For the first few weeks of their existence the baby lung-fish resemble tadpoles and are provided with suckers on the under-

surface of their heads, by means of which they attach themselves to the nest.

In the American Lung-Fish the eggs are laid in a subterranean burrow also excavated by the male, and having a total length of 4 feet. *Proptopterus* and *Lepidosiren* are both strictly carnivorous. In the aquarium when several of these fish are kept together they are liable to make a meal off one another's long vermiform fins, which, however, grow again in a very short time.

The Snake Fish, *Polypterus*, is another very ancient type of fish, now confined to the muddy rivers of tropical Africa. The scales are hard bony structures fitted together like the tiles of a roof. The body is elongate and the spines of the dorsal fin support several soft rays, which give the impression of a row of little sails. The young on hatching are provided with long external gills like those of newts and salamanders.

Probably the best known of the surviving " primitive fishes " are the members of the Sturgeon family, one of which, the Fresh-water Sturgeon or Sterlet, *Acipenser ruthenus*, of Eastern Europe, is sometimes exhibited in public aquaria. Although but a dwarf compared with the Royal Sturgeon, the sterlet, which seldom attains a length of more than $2\frac{1}{2}$ feet, is an impressive creature. It is heavily armoured from head to tail and ploughs up the river-bed with its pointed nose, devouring the worms, molluscs, etc., thus dislodged. Its flesh is excellent eating, its swim-bladder is convertible into isinglass, its roe affords caviare, and its liver pro-



BOW-FIN AND FRESH-WATER STURGEON OR STERLET.

duces oil. As a result the shoals which annually visit the great rivers of Russia are eagerly awaited by thousands of fishermen, and upon their arrival are attacked with spears and nets amid scenes of indescribable excitement.

Sterlets do well in the aquarium provided they are given cold water and are amply supplied with oxygen. Some specimens still living at the time of writing in Captain Vipan's private aquarium at Stibbingdon Hall have survived forty years of captivity.

Another survivor since a very ancient geological period is the North American Garfish, or Gar-Pike, *Lepidosteus*, which was very abundant in Europe during the Eocene and Miocene periods. It is characterized by a long slender beak and by hard bony scales which form a complete and impregnable coat of mail. The garfish will attack almost anything, and having caught its prey crosswise in its beak turns it round until the head end is in line with its mouth, whereupon the prize is bolted whole. In its method of capturing and devouring the fish it lives on, it in fact behaves exactly as does the slender-nosed crocodile or gharial of India. It is a hardy fish and has been known to live over twenty years in the aquarium.

The last of the primitive fishes to be mentioned is the Bow-Fin, *Amia calva*, a native of the Great Lakes of America. It is an elongate fish measuring up to 2 feet in length, with a long dorsal and a large rounded tail fin. Like the garfish, it owes its survival to

extreme hardness, unpalatability, and a domineering temperament. Zoo specimens, unlike nearly all other inhabitants of the aquarium, never become tame, and will not hesitate to snap viciously at the hand that feeds them.

During the breeding season we see a softer side to the nature of the male who takes upon himself all the cares of the family. First of all he constructs a large nest by clearing a circular space, several feet in diameter, amongst the rushes, biting some off, and beating others down with his tail. Having supervised the laying of the eggs, he guards them assiduously from the unnatural mother who would otherwise devour them.

The Carp and all the fishes to be referred to hereafter belong to the modern group of "bony fishes," *Teleostei*, which includes thousands of species. In this volume the group is headed by the members of the Carp family, and that for the reason that no other fish hold such a position in the affections of not only the aquarist, but of mankind in general. The birthplace of the carp is, according to tradition, centred in Korea. From thence the fish was introduced into China and Japan, and later to every quarter of the globe. In Japan the carp is associated with every conceivable phase of human life. It stands not only for a religious emblem, but also plays a part in public merrymakings. There it is a theme for the artist, whether in paint, bronze or verse ; a dish for the family board, and a



GARFISH TANK.

Facing p. 158.]

child's plaything. In Tokyo alone thousands upon thousands of huge paper carp-kites float above the rooftops to celebrate the "festival of baby boys."

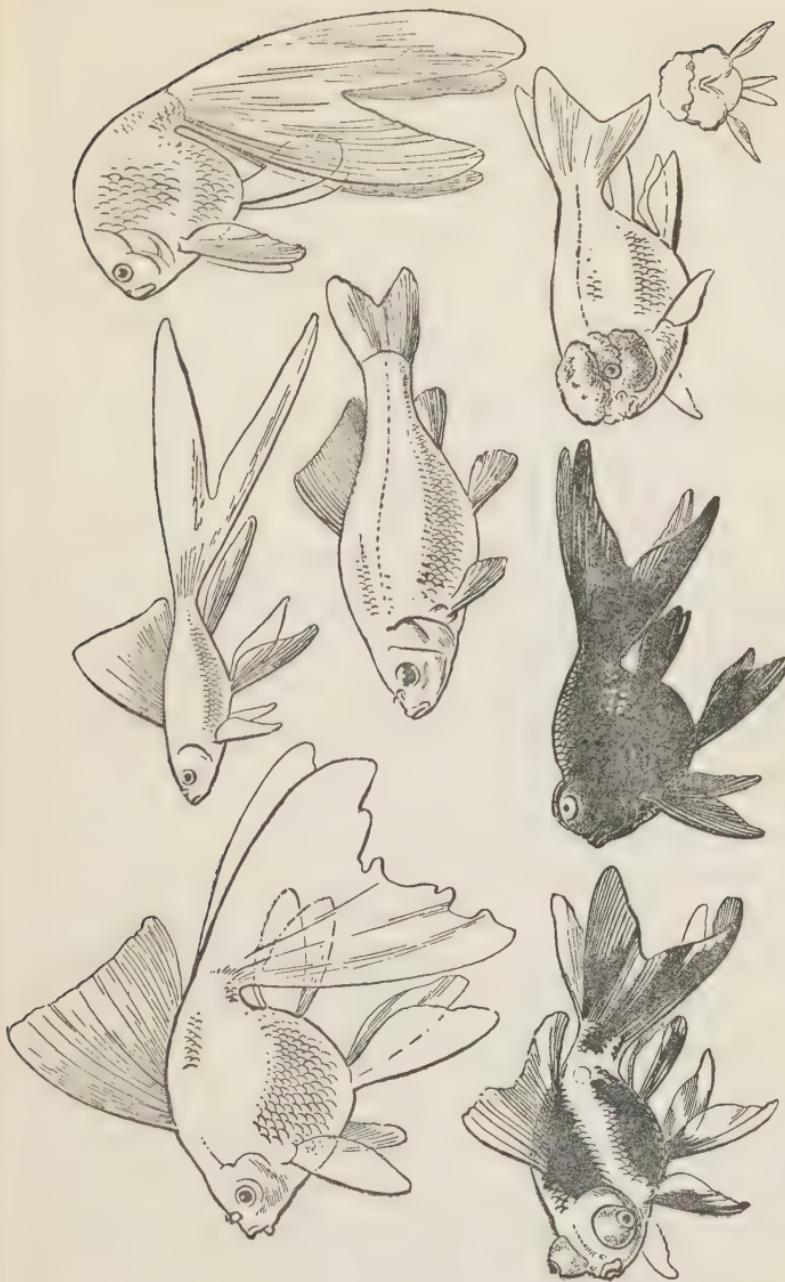
The Common Carp, *Cyprinus carpio*, is a heavily built fish of a dull greenish bronze colour, growing to nearly $2\frac{1}{2}$ feet in length and attaining a weight of 80 lb. It was once much valued in England as a food-fish, and although still popular as such on the Continent, is nowadays in this country only eaten by the Jewish population. The lake at Fontainbleau harbours some enormous carp, stated to be "white with age." Granted that these carp are very old—half a century or more,—their "rime of age" is only to be attributed to fungus which coats them with a dense but unromantic frost.

The Carp has penetrated nearly every portion of the globe in its natural, as well as its unnatural form—the goldfish. It has made its way in the world entirely on its merits, for it is at once the most intelligent and hardiest of all fish. Its brain power is evinced not merely by the tricks that it can be taught or by the readiness that in captivity it gets to know those who tend it, but also by the cunning it displays when confronted with the fisherman's baited hook. With regard to its hardiness, specimens have been known to survive a sojourn in water raised for several hours to a tropical heat, and to live through a prolonged internment in a block of ice. Moreover, the fish can exist out of its natural element for a considerable period, and can make

a twelve-hour trip by post packed in moist weeds, and appear "still smiling" on delivery.

As with many of our domesticated animals, its powers of adaptability have been abused. By interbreeding and selection, varieties have been produced some of which are really captivating, but others, at least in my opinion, are merely repulsive. Tastes, however, differ. The Comet Goldfish, with its long flowing tail, and the elegant Veil-tailed Goldfish, are amongst those that are certainly a delight to the eye. But what shall one say of such monstrous varieties as the Stargazer with its protruding eyes situated on the top of the head, and the Tumbler, a form which cannot swim straight by reason of a carefully cultivated curvature of the spine? It is comforting to reflect that Nature will have her way, and that a large percentage of fancy goldfish hark back to their old original form. In every brood of "goldfish" a number do not become gold, whilst only one out of a thousand comes up to "show" standard, the remainder reverting to the ancestral type. The Stargazer and Telescope Fish, for instance, all begin life with normal eyes, and only very few inherit the ocular disability which renders them so valuable to the fancier.

The goldfish is easily bred. A pond sufficiently large, with plenty of floating plants and immunity from foes, is all that is required. Given such conditions it will deposit its eggs usually in the spring, in batches of a dozen or two on the surface weeds until it has



VARIETIES OF GOLDFISH.

deposited about a thousand in all. Those eggs that have not been eaten by the parents will, in due course, hatch out into tiny fish-fry each provided with a yolk-sac attached to the underside. In about a month the young fish may be removed to other ponds or tanks well stocked with weeds and supplied with such food as *Daphnia* and *Cyclops*. Failing these, dried and finely ground cabbage or vermicelli may be supplied. Ants' eggs, unless absolutely fresh, have little nutritive value. It is not surprising that a fish so adaptable as the carp should have given rise to many varieties apart from those derived from the goldfish.

The Prussian Carp is a hardy fish distinguished by its deeper and shorter body, and by the absence of barbules on the lower lip.

The Mirror Carp or Leather Carp is a variety of scaleless carp in which the scales are either entirely absent, or scattered over the body in the form of a few large plates which reflect the top light of the aquarium with picturesque effect.

Another member of the family is the Bitterling, *Rhodeus amarus*, a small fish, so called from its bitter taste, inhabiting Central Europe. Owing to its strange breeding habits it makes a most interesting aquarium exhibit. The female is provided with a long tube which serves as an ovipositor, and by means of it shoots the eggs into the inhalent siphon of the pond mussel, *Unio pictorum*, the mollusc's respiratory current of water providing the necessary oxygen for the ova.

There is a curious system of "give and take" between the mollusc and the fish, the baby pond mussels usually spending one of their larval stages attached to the bitterling.

The genus *Barbus* embraces an enormous number of fish. It includes such diverse forms as the giant Mahseer, *Barbus mosal*, of India, a sporting fish attaining a weight of 250 lb., the Common Barbel, *Barbus barbus*, of our rivers which grows to a maximum length of 3 feet, as well as a vast number of small forms, inhabiting the rivers and streams of tropical Africa and Asia. Many of these small warm-water barbels are very hardy and in aquaria show off their brilliant silvery or golden hues to advantage.

The Common Barbel is immediately recognized by its long curved snout and its horse-shoe-shaped mouth, with two large barbules set almost underneath the head. Barbel swim about in shoals during the summer months, but in winter retire into the mud at the bottom of the river where they lie in a semi-dormant condition.

The Gudgeon, *Gobio gobio*, is a small fish similar in shape to the barbel. It has a predilection for fast-flowing waters, where it lurks amongst the boulders of the stream-bed. Although one of the commonest of European fish, the gudgeon is not known in Scotland.

The Roach, *Rutilus rutilus*, the Rudd, *Scardinius erythrophthalmus*, and the more slender Dace, *Leuciscus leuciscus*, are often kept in the aquarium. Although

amongst the most familiar of our fresh-water fish, difficulty is often experienced in discriminating between them. The use of the following key should render their identification easier :—

1. Dorsal fin more or less on a line with the ventral fin :—
 - (a) Dorsal fin with 7 or 8 branched rays *Dace.*
 - (b) Dorsal fin with 9, 10 or 11 branched rays *Roach.*
2. Dorsal fin far behind the base of the ventral fin *Rudd.*

The Dace and Roach are not satisfactory aquarium fish as both are very subject to fungus disease. The more handsome Rudd with its red fins and red eyes is much easier to keep in confinement and has been known to live for over ten years in captivity.

The Golden Orfe is a graceful pinkish-golden fish closely allied to the roach. It is a German product, being a domesticated variety of the Ide, *Leuciscus idus*, and is imported into this country in very large numbers. It is a comparatively hardy fish, suitable for ornamental garden pools.

The lively little Minnow, *Phoxinus phoxinus*, which does not grow to a length of more than 4 inches, does well in the aquarium, and a shoal of these fish makes an attractive exhibit.

The Common Bream, which has a deep and very strongly compressed body, may attain a weight of

18 lb. It swims in large shoals and inhabits lakes and slow-running rivers. It is an ornament in the aquarium where it unfortunately does none too well, large specimens being specially susceptible to fungus disease. The bream frequently hybridizes with the roach, the hybrid fish resembling a slightly deeper roach. Bream and rudd hybrids have also been recorded, but are not so common.

The Loaches are long-bodied fish of small size, practically devoid of scales, and having the lips fringed with a beard of six or more barbules. Their air-bladders are in close connection with their skin and ears, with the result that changes in temperature and pressure are at once appreciated.

The Common or Stone Loach, *Cobitis barbatula*, becomes very restless on the approach of a thunder-storm, whilst the Weather Fish, *Misgurnus fossilis*, is so hypersensitive that it is kept in small tanks in many continental households to play the part of a barometer.

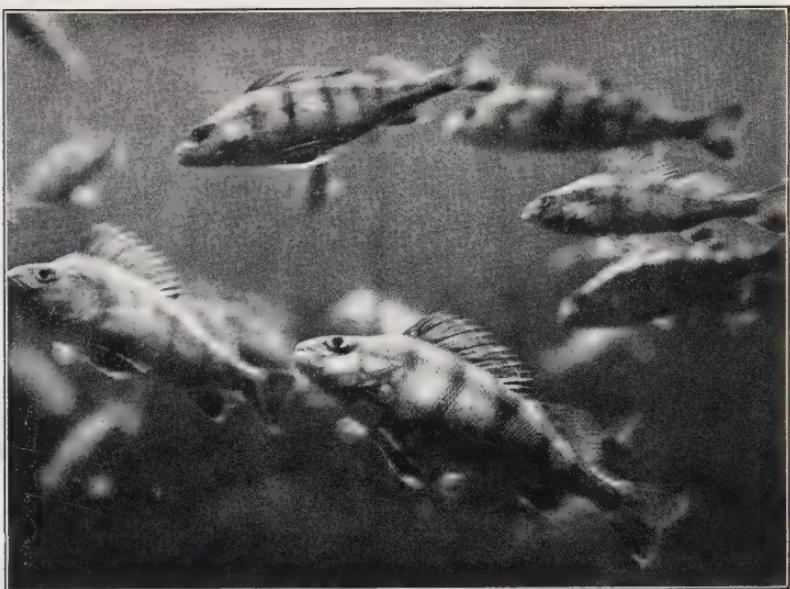
There is no more suitable fish for the aquarium than the large deep-bodied Tench, *Tinca vulgaris*. Its minutely scaled greenish-bronze skin is intensely slimy, a feature which our forefathers were quick to explain in their own peculiar way. The tench was known as the "doctor fish," and it was maintained that its slime possessed medicinal qualities, not only for human beings, but for other fish as well. Like carp, tench hibernate during the cold weather, secreting themselves in deep holes beneath the roots, and in the

banks of the ponds or rivers they inhabit. It happens on occasions that a fall of soil imprisons the fish, and some extraordinary specimens of tench grown to the conformation of their cells in which they have been incarcerated for years, have from time to time been "dug up." Twelve pounds is regarded as its weight limit in this country. A domesticated variety has acquired a colouring similar to that of the golden orfe and is known as "Golden Tench."

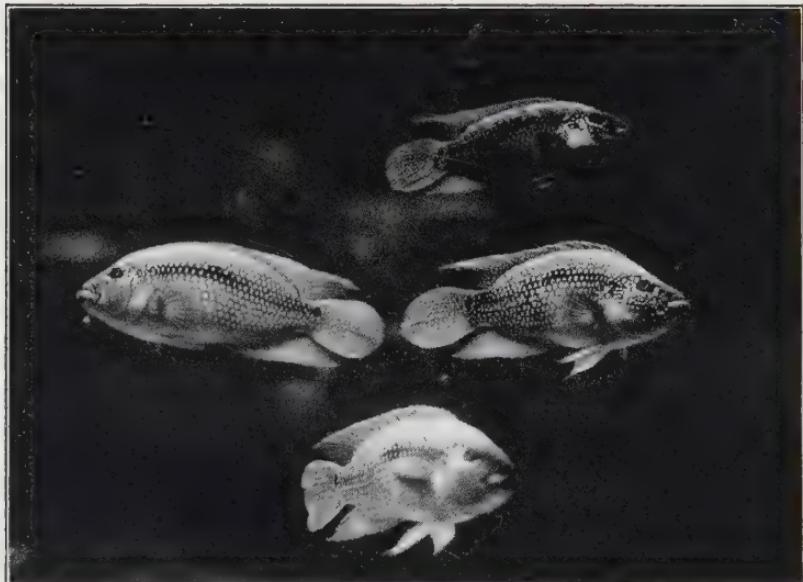
Amongst the smallest of fish are those Asiatic members of the carp family known as Zebra Fish from their striped patterns.

The very active small Zebra Fish, *Danio rerio*, of the East Indies, which measures barely an inch in length, is a very striking fish, its cream-white body being longitudinally striped with blinding metallic blue. Its minute eggs may, at a temperature of about 75° F., be deposited on the floor of the aquarium, but as both parents are apt to devour them, with the exception of those laid in large vessels thickly planted with weeds, very few ever hatch out in captivity.

The Perch, *Perca fluviatilis*, with its more or less humped back, large spiny dorsal fin and barred pattern, is too well known to need a detailed description. It is common nearly all over Europe and represented by very closely allied species in North America. Sir Izaak Walton described the perch as "a very bold, biting fish," and that is a very apt description of its character. Although sociable, and travelling peaceably in large



[Photograph by Neville Kingston.
COMMON PERCH.]



[Photograph by Neville Kingston.
CICHLID PERCH.]

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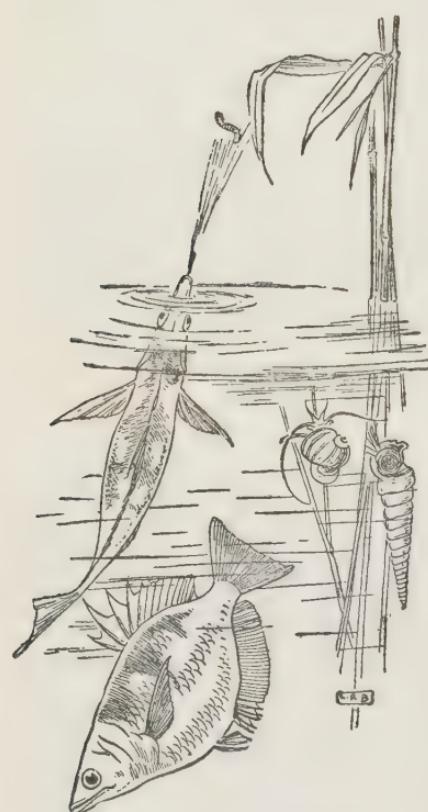
shoals, it is individually very pugnacious and will feed upon almost anything it is able to swallow. It does well in the aquarium and will refuse nothing in the way of food. Care, however, must be taken to prevent it becoming associated with other fish. Its average weight is a pound and a half, although five-pound specimens have been recorded from the Welsh Lakes. About two hundred thousand eggs are laid in March or April and are set in a white gelatinous mass of ribbon-like form, suggestive of a scarf which has accidentally fallen into the water and become entangled in the weeds.

The Ruffe or Pope, *Acerina cernua*, is closely related to the perch, but distinguished by its smaller size, dingy buff colouring, and the arrangement of its two dorsal fins which, instead of being separated as in the perch, merge into one another. It inhabits all parts of Northern Europe, frequenting quiet waters where it swims placidly close to the bottom. It entirely lacks the fire and vivacity of the perch, and in captivity hides away in crevices in the rockwork of its aquarium. For some strange reason this harmless little fish in mediæval times shared with certain other animals a reputation of being in league with the devil, and was in consequence made the subject of a cruel and senseless persecution. The pious men of those times, having enjoyed a protracted orgy of devotion, sallied forth with rod and line to spend the afternoon "corking the pope," a sport which consisted of catching the fish and

then decorating the tallest spine of its dorsal fin with a cork. The wretched creature was then returned to the water, where it afforded much holy mirth by its vain efforts to swim down to the river-bed. The chroniclers inform us that

the water might sometimes be seen covered with thousands of these bobbing corks, each one denoting a "pope" doomed to starvation.

The perches of the family *Centrarchidae* are mostly inhabitants of North America. The most beautiful member is the green, blue and orange Sun Fish, *Eupomotis gibbosus*, which is characterized by a scarlet blotch on the gill-covers. It is a very hardy fish and has been bred in ponds in this country.



ARCHER OR RIFLEMAN.

One of the most entertaining of all tropical aquarium fish is the perch known as the Archer, or Rifleman, *Toxotes jaculator*, a native of the rivers of the East Indies and Northern Australia. It derives its popular

name from its habit of capturing the insects upon which it lives by shooting water at them, and in the Malay Peninsula it is commonly kept in captivity for the display of this amusing habit. Its strongly developed jaws form a spout, through which it suddenly ejects a spray with such force as to bowl over the insect that may be resting on the overhanging riverside vegetation.

The perch-like fish of the family *Cichlidæ* embrace some three hundred species, most of which are confined to Africa and tropical America. They are mostly small fish, rarely exceeding a foot in length, and are remarkable for their brilliant ever-changing colours. Most interesting are their breeding habits. In the spring the newly wedded pair commence house-building by the simple process of engulfing mouthfuls of sand from a selected site, and dumping the sand so gathered some distance away. In time a deep pit is formed in which the eggs are laid. Sometimes several pits are dug and the eggs are transferred in the mouths of the parents from one to the other. Last year a pair of Zoo cichlids were encumbered with an unusually large family, the said family being much persecuted by other fish tenanting the same tank. The parents in consequence were constantly "moving." They took turns in digging out fresh nests, and as each neared completion first the eggs, and at a later stage the young were transferred by the mouthful. In spite of the fact that the building and baby-carrying were

constantly hindered by the interruption from neighbours, the two fishes managed somehow to accomplish their purpose and most of the young were reared. Upon hatching, the infant fish were very carefully guarded, and more or less confined to the nursery. It was a harassing time for the parents, for the babies at an early stage developed a tendency to "stay out late" and had to be brought back, sometimes as many as twenty at a time, in the parental mouth.

In some species both parents share the responsibilities attendant on a family of a hundred or more; in others one parent only takes charge, the other showing a tendency to feast upon the progeny.

The female Mouth Breeder, *Paratilapia multicolor*, for instance, gathers up the eggs into her mouth as soon as she has laid them, and there retains them, her cheeks swollen to almost cracking-point, until the young emerge. For some weeks after they have hatched the little cichlids on the appearance of father return hastily into their mother's mouth.

The Angel Fish, *Pterophyllum scalare*, although rarely exceeding 10 inches in length is the most spectacular of all aquarium fish. In shape it is much taller than long, and is more compressed than a flat-fish or John Dory. Its extraordinary depth is much accentuated by the vertical bands which extend from the tip of its huge dorsal fin to the bottom of the anal fin. These bands, which appear and disappear suddenly, have the effect of making the tank the fish inhabit



THE ANGEL FISH TANK.

Facing p. 171.

appear much deeper than is actually the case. The capture of the angel fish is no easy matter, as not only does it inhabit waters infested with anacondas and electric eels, but owing to its highly compressed form is all but invisible when seen from above. The collector, working by the lantern light in the cool of the evening, is only aware of the presence of the fish by its narrow shadow cast upon the floor of the stream. Towards the shadow he directs his net, and by a swift upward movement may—or may not—land his fish. When one adds a swarm of super-mosquitoes to the beforementioned anacondas and electric eels, in addition to a host of other distracting animals peculiar to the Amazon, it will be appreciated that angling for angel fish is by no means an easy or comfortable sport. The angel fish has been bred in the aquarium. Its eggs, deposited on the leaves of plants floating in shallow water, are aerated by a rapid winnowing motion of the parental fins. So violent are the amorous antics during the breeding season that they suggest a duel to death rather than a courtship.

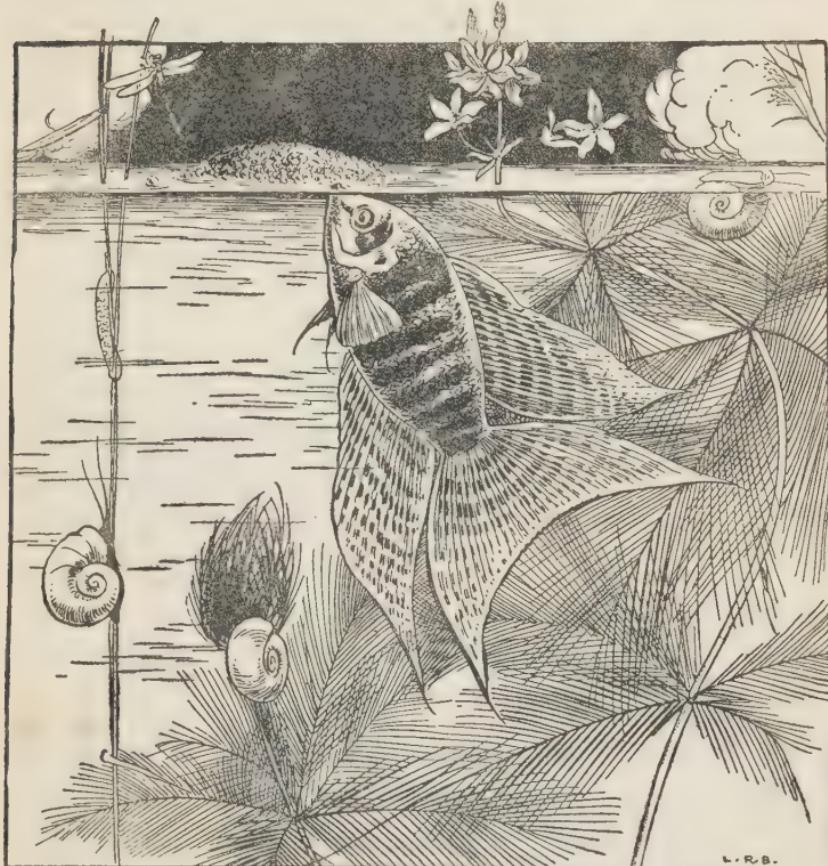
The notable aquarium fish belonging to the families *Anabantidæ* and *Osfphromenidæ* are able to breathe atmospheric air, and are provided with an accessory air-cavity situated beneath the gill-covers in which air can be stored for comparatively lengthy periods. Thanks to this air-chamber, some of them can live for several days at a time out of water, and survive when other fish succumb to the drought.

The so-called Climbing Perch, *Anabas scandens*, of tropical Asia, if the reports be true, can not only clamber over the mud and shingle of a sun-dried water-course, and so make his way to the nearest puddle, but can even ascend trees, although why he should perform the latter feat is difficult to explain. In the aquarium he belies the title which has made him famous, for he cannot be induced to climb. The fact remains, however, that he is said to do so in his native land and is well adapted to perform the feat, and to breathe comfortably whilst thus engaged. The climbing is accomplished by means of certain sharp spines set on the gill-covers and also on the fins which are used as climbing irons. By muscular contortions the fish fixes the spines into any convenient crevice and then using them as levers pushes himself forward.

The climbing perch is a hardy fish and can stand extremes of temperature.

The Paradise Fish, *Macropodus viridi-auratus*, is a gorgeously tinted fish, hailing from China, and is not much longer than its scientific name as printed above. When the time comes for family cares the male fish rises to the surface and blows bubbles until a frothy fairy-like nest is constructed. With each puff from its mouth a sticky secretion is extruded so that the bubbles hold together and form a frail yet durable mass. The eggs, as soon as laid by the female, are taken up into the mouth of the male and carefully deposited into the nest. The father then mounts guard and defends the

contents of the prismatic nursery from enemies, of whom the chief is the mother—a lady with infanticidal tendencies. In the building of this “bubble nest,” the gills with their ample reserves of imprisoned air



PARADISE FISH.

play an important part, and indeed make the fashioning of the homestead possible.

The Gouramis, *Osphromenus*, are also builders of “bubble nests.” The group is distinguished by the

peculiar breast fins, one ray of each being developed into a long filament which is apparently used by the fish to feel its way about.

Every creature capable of putting up a fight has been made at some time or other to minister to our blood lust, and the pugilistic gifts of the little Fighting Fish *Betta*, were early appreciated in the country of its origin—Siam. Enormous fortunes have been lost on horses and at cock-fights, but the Fighting Fish must surely outvie all other creatures in the influence which an animal can exercise over man's instinct for gambling. Until a fairly recent date devotees of these fish fights were wont to stake not only their last coins, but their entire estates and as a final desperate expedient their personal liberty and that of their family. It was in fact a common occurrence up to the early part of last century for a "loser" to undergo several years of slavery to his successful competitor.

The accounts of these fights make romantic reading. The spectators squat, tier upon tier, on cushions or mats round a glass bowl suspended from the ceiling by a rope, into which the two male fighting fish are placed. The rivals, each little more than an inch in length, at once engage. Their fins rise, their mouths open, and their bodies glow with a truly Oriental splendour. From the outset the pace is furious. In a few moments the bowl is a froth of bubbles in which the combatants are all but invisible. A "round" lasts but a few minutes, and so great is the damage

entailed that a fish rarely fights more than once, after which, if he lives, he is relegated to the stud. The excitement created by such fights has been described as quite amazing and by the close of a spirited contest most of the concourse is on its feet.



FIGHTING FISH.

Like the Paradise Fish, the Fighting Fish are bubble-nest builders, and will breed in aquaria of a depth of not more than 6 inches.

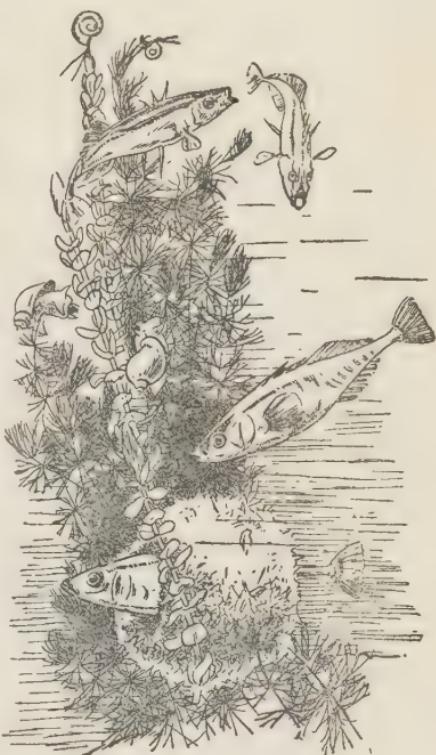
The "tiddler" of the juvenile anglers or Three-Spined Stickleback, *Gasterosteus aculeatus*, is not suited

to the companionship of other fish. It is, however, a great asset in the aquarium, where in the spring its courtship and the care with which it guards the eggs and young may be observed, affording much entertainment. The males, always pugnacious, then become extremely savage, and put on gorgeous tints, their backs assuming a glowing emerald and azure-blue colour, and their bellies a flaming crimson. The prospective husband constructs a barrel-shaped nest of weed fragments and twigs bound together with a gum secreted from the kidneys. The work of building completed, courtship begins, and this as a rule leads to furious battles with rival suitors. Several wives are in turn, by force or persuasion, led to the nest where the eggs, which are defended by the fickle husband, are deposited. Any creature—another fish, a newt or a beetle—approaching the nursery is immediately assailed by the father “tiddler” with incredible violence. He can inflict painful wounds with his dagger-like spines, and a pitched battle between two of these tiny swashbucklers frequently ends fatally for one or the other.

The more slender Ten-Spined Stickleback, *Pygosteus pungitius*, is less abundant than the above, but is equally adaptable to the aquarium. It differs from the common form in lacking that fish’s defensive plates on the side and tail, in having ten spines ranged along its back, and by constructing a nest on different lines. Whereas the “tiddler” builds on the bottom, ram-

ming his nest together by using his snout as a pile driver, his more slender cousin secures his nest to the upright stems of water plants not far from the surface. During the breeding season the male fish, instead of assuming brilliant colours, becomes jet black.

The African and South American family, *Characinae*, numbers in its crowded ranks some very formidable forms. All are well armed with powerful teeth, which are sometimes clearly visible when the mouth is closed. Several species grow to a very large size and in the Nile district are called "Dogs of the Water." The "Cariba," *Serrasalmo*, of South America has long been notorious for a very evil reputation, as it grows to over 2 feet in length, and hunts by scent. The faintest tinge of blood in the water at once attracts these fish, and often the mere presence of a warm living body is sufficient to draw them to the feast in vast shoals. Human beings, deer, jaguars and tapirs have been literally hewn to pieces by the



STICKLEBACK.

razor-edged teeth of these indomitable tigers of the river-bed.

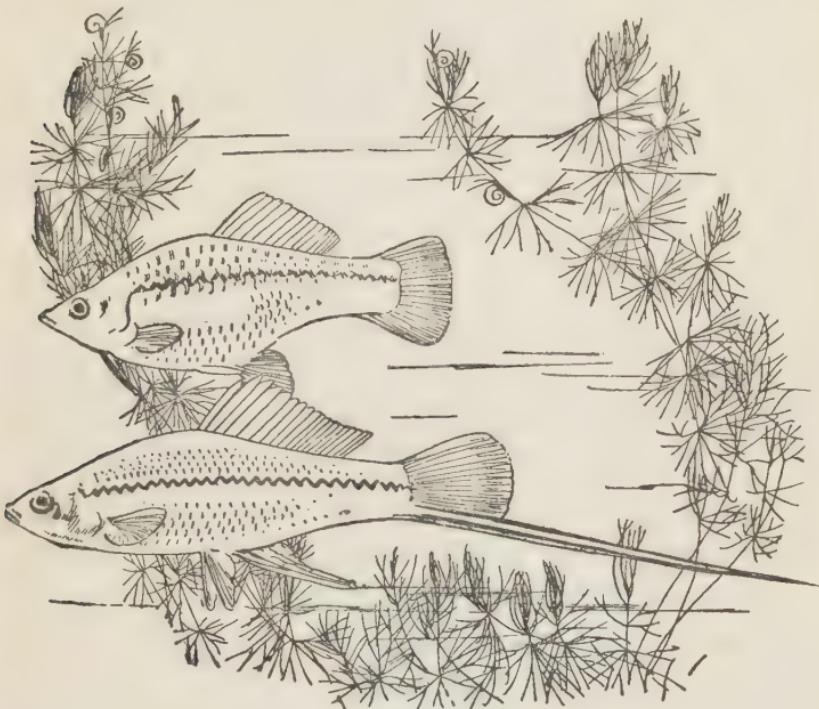
Some of the smaller members of the family such as those belonging to the South American genus *Tetragonopterus* do well in the aquarium. Amongst the most attractive of these are the Beacon Fish, *Tetragonopterus ocellifer*, with its flashing ruby-red eye-spots on the tail, and the X-Ray Fish, *Tetragonopterus unilineatus*, whose flesh is so transparent that the internal organs can be quite clearly studied through the body wall.

The Jumping Fish, *Carpeina arnoldi*, is another hardy aquarium fish, remarkable for its breeding habits. The eggs are laid out of the water, the parent leaping clear of the lake or river and depositing the eggs singly on some overhanging leaf or branch, whilst in mid-air. Some 200 eggs are thus installed by the female, who then transfers the parental duties to her partner. His task is to keep the eggs moist until they hatch, which he accomplishes by splashing them by beating the water with his tail.

In striking contrast to some of the formidable fish just described are the members of the family *Cyprinodontidæ*. They are all of very small size with flattened heads. A large number are suitable for exhibition in the aquarium. Some forms are oviparous, whilst others bring forth their young alive.

The Swordtail, *Xiphophorus helleri*, of Mexico is a living gem some 5 inches in length. The sword-like

elongation of the tail fin is essentially a male character, as is the spike-like development of the anal fin which serves as an intromittent pairing organ. The females of these fish in their third year, and after having delivered themselves of their living young, occasionally



SWORDTAIL.

change sex, assuming the male characters. The explanation offered is that as normally the males are far outnumbered by the females the sudden change of sex is an attempt on the part of Nature to equalize the odds, and maintain a sufficient balance of the sexes to ensure the survival of the race. The swordtail frequently

interbreeds with closely allied species. A very beautiful sport—one frequently seen in aquaria—is known as the Golden Swordtail and is the result of a cross between it and a little golden fish, *Platypæcius maculatus*.

The tiny fish, *Lebistes reticulatus*, known as the “ Millions ” Fish, one of the hardiest of all the small tropical aquarium fish, has been successfully employed to stem the tide of malaria in the West Indies, as disseminated by the *Anopholes* mosquito, and efforts have been made to acclimatize it in the tropical haunts of the mosquito all over the world. As in the case of most fish the male is much smaller than the female, and is much more brightly clad. The females are simply dull olive grey in colour, whilst the males are conspicuously ornamented with red, blue, violet and yellow, with a dark ocellar spot situated in the middle of the body and another at the base of the tail fin. The males are remarkably active and are perpetually courting the females, going through all kinds of antics in their endeavours to attract attention.

Breeding goes on all the year round, at least in captivity, and the females are in an almost permanently pregnant condition, for within a month of having brought forth a brood of from fifteen to twenty-five young fish, they bring another family into the world. The little “ millions ” grow rapidly : about 4 m.m. at birth, they double that length in a fortnight or so, when their sex can be determined by the shape and position

of the anal fin; it is not, however, until they are about two months old that the males become adorned with the brilliant markings which characterize the adult.

The Sail Fin, *Mollienesia latipinna*, of Mexico is remarkable for the astounding development of the dorsal fin in the male, the depth of which when fully erect is at least twice that of the body. It is an inhabitant of brackish rivers, but becomes thoroughly acclimatized to fresh-water.

The little minnow-shaped Mother-of-Pearl Fish, *Cyprinodon dispar*, which inhabits the streams of nearly the whole of tropical Asia and Arabia, flourishes in the aquarium at a temperature of 70° F. It is, however, able to withstand tremendous heat, as it occurs in the steaming hot springs of the Hufuf oasis in Arabia, where the temperature never falls below 100°, and sometimes rises to 110°. How the fish found their way to this oasis is a mystery, as the nearest open water system is over 400 miles away from the springs. It has been suggested that their eggs were originally carried attached to aquatic weeds in the claws of birds visiting the springs.

The Dwarf Pike, *Belonesox belizanus*, also of Mexico, is the only aggressive member of the family. This pike-like fish, which rarely measures more than 5 inches in length, adopts the stalking methods of its namesake, engulfing any small animal it can overpower. Newly imported specimens will only feed on living objects

such as small crustaceans, mosquito larvæ, tadpoles, etc., but in time come to appreciate a meal of finely shredded liver or heart.

The Salmon family is in Great Britain represented by several species, of which the trout, and the salmon in its young stages, are the only members to live any length of time in the aquarium.

A veritable flood of literature is annually poured forth as a result of up-to-date investigations into the life-history of the Salmon, *Salmo salar*, at once the most beautiful and valuable of all our fresh-water fishes. The salmon lives in the sea, entering the rivers in about its third year to spawn, and may continue to make annual visits up-stream for this purpose throughout the remainder of its life. When spawning time approaches, the lower jaw of the males becomes greatly enlarged and curls up at the end. The front teeth likewise grow excessively long,—a provision for the courting season in the autumn, when deadly battles take place between rival males for the possession of the females. The "hen"-salmon makes a hollow in the river-bed with her tail and places successive layers of eggs therein, covering each batch with a blanket of gravel. In about four months the infant fish, or *alevins*, hatch out. The young salmon grow 6 to 8 inches in length in the course of their first two years, when they are termed *parr*. They are then light brown in colour with dark blotches or bars, and are difficult to distinguish from trout of the same age. In the follow-

ing year, when in what is known as the *smolt* stage, they assume the bright silvery tints of the adult form, and make for the sea. Having waxed fat in the salt water the fish returns to the river where it was hatched. Its instinct of orientation is developed to a very high degree, for however often it may return it persists in visiting its birthplace.

The salmon carries its life-history indelibly written on its scales, which bear annular rings like those evident in the cross-section of a tree. Where the fish has grown apace and put on much flesh the rings are far apart. Where feeding has ceased, as in the spawning season, the rings are close together. Experts can, by an examination of the salmon's scales, not only estimate the age of a given fish to within a year, but can even sometimes state in what river the fish was hatched. The salmon presents many knotty problems in the aquarium. An effort is being made at the Zoo to gradually acclimatize the fish when they reach the smolt stage to sea-water.

The Brown Trout, *Salmo trutta*, is distinguished from the salmon by several anatomical features. Apart from the difference in colouring and markings, in the position of the upper jaw we have a character by means of which we can distinguish between the two fish, its base in the case of the salmon not extending, or extending but little, beyond the eye, whilst in the trout it reaches far behind that organ. The trout and its varieties are known by hundreds of different

names in Great Britain, although scientific authorities recognize but a single species.

The British Trout, the American Rainbow Trout, *Salmo irideus*, and the American Char, *Salmo fontinalis*, will all thrive in large aquaria provided the water is well aerated and kept throughout the year at a temperature of below 55° F. In warmer water they are liable to a fluke infection of the gills, which usually proves fatal.

The familiar Pike, *Esox lucius*, is abundant in North America as well as in Europe, and since the dawn of history the two continents have vied with each other in the recounting of "fishermen's tales" concerning this ogre of the river. Like all other fish, it grows continuously throughout life, so that it is difficult to assign a size limit for the fish. According to Major S. S. Flower, who has made a study of the duration of life of these animals, nothing very definite can be said as to the age to which a pike may live, but he is of the opinion that giant specimens weighing 60 to 70 lb. are as many years old. Statements that they live for centuries he regards as mere fables. The fish is known by various names,—Gedd in Scotland, Jack, and Pickerel, the latter dating from mediæval times.

The pike is a veritable water tiger, as regards coloration as well as strategy. Its striped sides blend perfectly with the streaky pattern of the flags and rushes, varying in tint with the changing seasons. The fish approaches its quarry with a scarcely perceptible move-



{Photograph by Central News.

PIKE

Facing p. 185.

ment. Then suddenly it makes a rush. If unsuccessful it once more settles amongst the weeds, and bides its time until another opportunity offers. Its capacity for nourishment can scarcely be exaggerated. Pike have been known to seize the human hand incautiously dangled over the boatside, and there is an authentic instance recorded of a pike engulfing the head of a swan which happened to be groping for water weeds at the time. Fish, frogs, rats, and young water-fowl are amongst its common victims. That it is an intelligent fish was demonstrated some years ago in a certain aquarium where a specimen kept in a small tank had for its companions several roach. As the pike soon exhibited his aggressive nature, to save the roach, the inexperienced keeper who had introduced them erected a dividing glass partition. The pike persisted in stalking his tank-companions, but with disastrous results to himself. Having struck his snout against the invisible barrier several hundreds of times, it eventually dawned upon him that nothing was to be gained by his attacks, and he eventually lost interest in the subject of roach. Some months later the barrier was removed, but the pike, having grown to associate them with "one on the point," was taking no more chances, and left the roach severely alone. At any rate he never made another attempt upon their lives, although strange fish introduced were immediately attacked and devoured. The male pike suffers much from domestic strife. He is much smaller than the

female, and a prolonged courtship not infrequently ends in the lady making a meal of her suitor.

The Common Eel, *Anguilla vulgaris*, can live in either fresh or salt water. Its romantic life-history, although until quite recently shrouded in mystery, is now more or less common knowledge. Prior to its discovery the eel's existence was explained in many curious ways, the early naturalists being in favour of the theory that the fish were evolved from horse hairs that had fallen into the water. It is now established that the eel breeds far out in the deepest parts of the Atlantic, near the Azores, and that the young, which are at first transparent ribbon-like creatures, travel via the Gulf Stream towards the shores of Europe. On arrival, although very tiny, they have attained the parent form, and at once proceed to invade the rivers in immense numbers. For several years they haunt the fresh-waters, until on reaching maturity they make for the Atlantic breeding grounds, from whence they came, there to propagate their species—and die.

Nothing comes amiss to the eel at dinner-time. Molluscs, insects, fish, water-rats, and young birds "all go the same way home,"—if the eel is large enough to accommodate them. Eels have, in fact, on various occasions, been found choked to death as a result of attempting mouthfuls that proved too big for them.

Although content to lie concealed in the mud by day, the eel becomes very active at night, and when kept in an aquarium, its tank should be securely

covered. Large specimens will travel great distances from one pond to another by wriggling overland, their peculiarly constructed gills enabling them to live for many hours out of water. A Zoo eel persisted in climbing out of its official tank night after night, and establishing itself in one containing some sea-anemones several tanks away. Its determination was such that it eventually had its own way, and with the anemones it lives to this day.

The very large family of Cat Fishes has representatives in every quarter of the globe. A large number occur in temperate waters, whilst the tropical members are legion. The cat fishes form an interesting group. A few are provided with an accessory breathing apparatus which enables them to live out of water for several hours, whilst nearly all can exist in water that would be considered too foul to sustain any ordinary fish. Although the majority are heavy and slow in movement, a large number are well insured against attack, either by their bodies being covered with bony plates, or by possessing sharply pointed fin-rays with which they can inflict highly poisonous wounds. A few enjoy the eel's capacity for travelling overland, and at least one kind emulates the mouth breeder in the nurture of its young.

The term cat fish is, of course, derived from the more or less noticeable barbules which depend from the lips of all the members of the clan, and vary in number from one to four pairs.

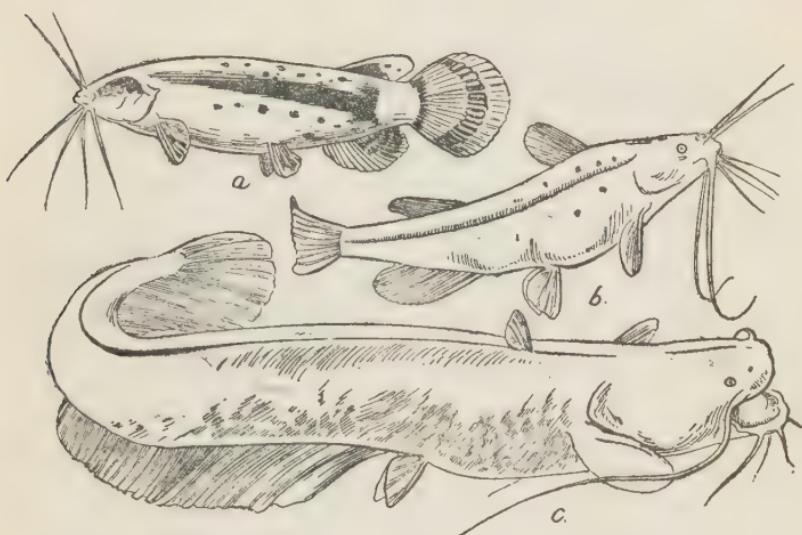
A lavishly whiskered form is the hardy Common American Cat Fish, *Amiurus nebulosus*, which can be bought at all aquarium dealers for a few pence.

Its eggs, which are seldom laid in captivity, are in its native haunts deposited in a nest of mud, the joint work of both parents. On their hatching, the male has been described as leading the young in great schools, caring for them as a hen for her chicks.

The huge Wels, *Silurus glanis*, of Central Europe is abundant in the Danube, where it attains a length of 10 feet and a weight of over 400 lb. The largest European fresh-water fish, it must attain a very great age, as a 4-feet-long specimen living in the Zoo aquarium was received only a few years back from the Duke of Bedford's lake at Woburn into which it had been introduced over fifty years ago. Amongst the queerest of the cat fish that may at any time arrive at the aquarium is the Floating Cat Fish, *Synodontis membranaceus*, of Africa, which is unique in that it elects to spend much of its time swimming upside down with its back fin pointing towards the river-bed, and its "tummy" exposed to the air. In this strange posture it is often depicted in the mural paintings decorating the tombs and monuments of the ancient Egyptians.

Another common African form is the Electric Cat Fish, *Malopterurus electricus*, a dull sluggish creature with a mottled velvety skin and measuring up to 2 or 3 feet in length. Its powerful electric organs extend throughout the entire body and are of unusual interest

since they are not, as in other electric fish, derived from modifications of the muscular tissue, but are developed from the glandular system. The apparatus is controlled by a single nerve on each side, and can be set working at the will of the fish, which uses its power with often deadly effect. Swimming slowly alongside its prey it suddenly creates a contact by

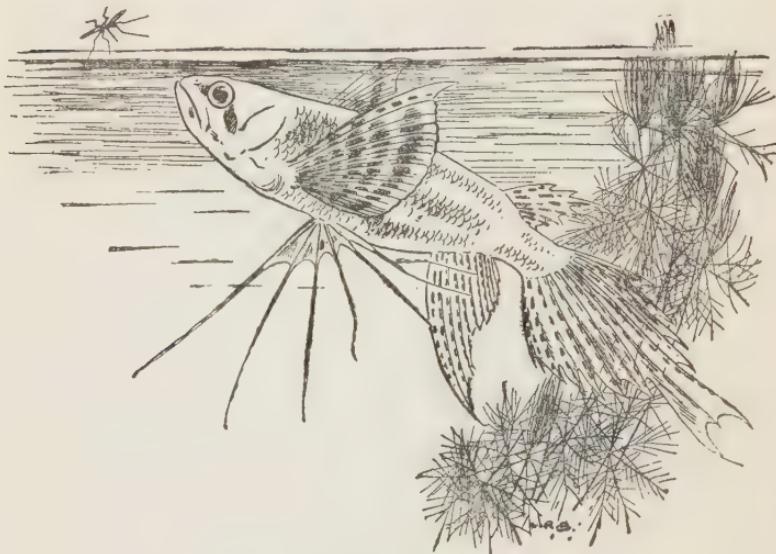


CAT FISH.

(a) Electric Cat Fish. (b) Common American Cat Fish. (c) Wels.

deliberately touching its quarry, and the force of the shock may be appreciated from the fact that a small specimen will quickly account for all its tank-mates. The strangest feature of this very queer fish lies in that it does not shock other fish to death with the desire of feasting upon them, its object being to force its prey to regurgitate, when it feeds upon the half-digested food vomited forth in the throes of death. The skua

gull appears quite a pleasant character by comparison since, after having secured its meal by bullying methods, it permits its victims to depart little the worse for their rough handling. Known to the Arabs as the "thunder fish," the electric cat fish, contrary to what one might expect, is excellent eating, and regarded by the natives as a great delicacy.



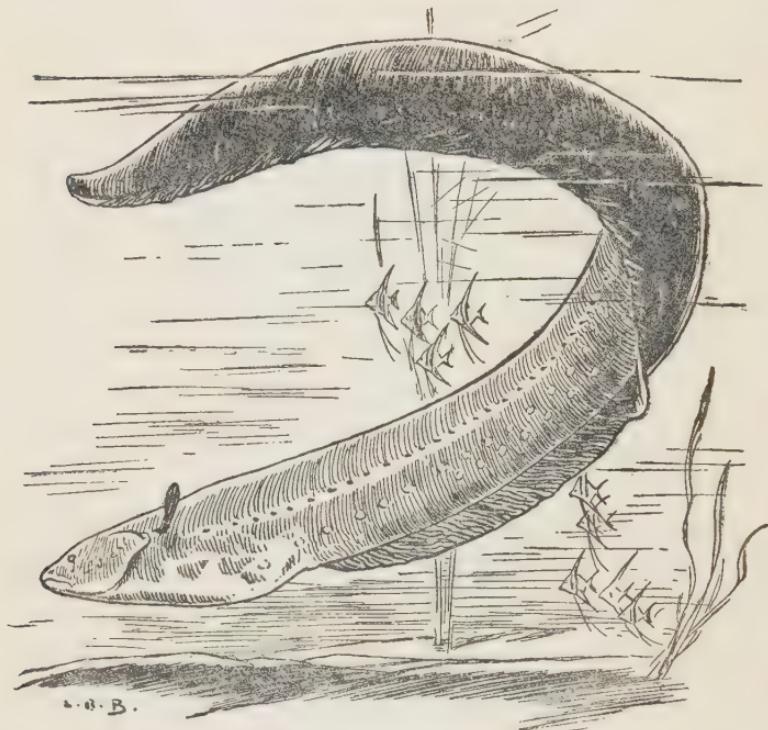
BUTTERFLY FISH.

The Butterfly Fish, *Pantodon buchholzi*, is for all practical purposes a fresh-water flying-fish. Thanks to its wing-like breast fins it can plane for distances of several feet over the water, a faculty which not only enables it to avoid its many foes in the West African rivers it inhabits, but enables it to capture the insects upon which it lives. Its activities are usually confined

to the evening, spending the daytime near the surface of the water where it lays its eggs. The spawn hatches in three or four days at a temperature of 75° F. From thence onwards the aquarist's troubles begin, for the young are not only exceedingly delicate, but grow very slowly and the parents disclaim all responsibility for their upbringing. The first butterfly fish brought to this country was captured in a butterfly net.

The famous but misnamed Electric Eel, *Gymnotus electricus*, of the Amazon River is a very hardy fish, several specimens having been kept at the Zoo for over ten years. Scientifically speaking it is a degraded form of tiger fish, but is much too elongate in form to be known by any other name but that of "eel." The fish grows to a length of 8 feet and is dull grey in colour, except for the lower surface of the body which is cherry red. Four-fifths of the "eel" consists of the tail. Indeed, this organ commences but a few inches from the creature's throat, and in it are stored the electric organs which are modifications of certain muscles, fashioned to form cylindrical cells, packed with a stiff jelly-like substance, richly supplied with nerves. The electric power varies according to the size of the fish, but in very large specimens it has been estimated to be the equivalent of 400 volts. Many are the lurid stories that have been circulated regarding the electric eel. It is undoubtedly a real nuisance to travellers in the swampy districts of the Amazon, often disorganizing their caravans by "shocking" the

beasts of burden. We must, however, accept with caution the vivid accounts of the famous traveller Humboldt, who has asserted that it was occasionally necessary, in order to put the electric eels out of action, to drive a number of horses into the streams or swamps



ELECTRIC EEL.

it was proposed to cross. He has stated that the eels, having expended their electrical powers upon the luckless horses, could be captured and handled with impunity.

We shall conclude our review of the fresh-water

fish that have at one time or other been kept in the aquarium, with the Mud Skipper or Walking Fish, *Periophthalmus Koelreuteri*, a goby previously referred to, inhabiting all the tropical parts of the Eastern Hemisphere, where from the earliest times it has attracted attention by its grotesque form and strange habits. Many fishes, such as the eel, lung-fish, and climbing perch, leave the water when forced to seek fresh pastures owing to drought. The mud skipper, however, does so by choice, and whenever the mood takes him, this quaint little creature with his clownish face, and huge goggle eyes set high up on the head, clammers ashore by means of his stout and supple breast fins, and behaves more like a lizard than a fish. He basks in the sun, and lying at ease on some convenient stump or rock snaps up passing flies inaccessible to the average fish confined to the water. The mud skipper can scuffle along on land at a fair speed, and on alarm will take a header into the water. He, however, rarely ventures "out of his depth," but prefers to rest in shallow water with his head just protruding above the surface.

CHAPTER III

AQUATIC BATRACHIANS

THE name "Batrachian" has been in current use since the days of Linnæus. Prior to that period the frogs and salamanders were known as Amphibians, an elastic term commonly regarded as implying an animal that was unable to live on land, and apt to die in the water,—one, in fact, dependent upon both environments in order to exist.

Batrachians stand midway between the reptiles and the fishes and constitute a link in the chain of evolution. In their early stages they have much in common with fish, whilst on reaching maturity they often bear a superficial resemblance to reptiles. The majority when adult are only partially aquatic, but a few never tear themselves away from their watery nursery and so are eligible for election to the aquarium. Not so very long ago the Batrachians were the subjects of the wildest speculations, and gave rise to the most extravagant stories. It was commonly held, for instance, that frogs descended from the sky,—in conjunction with a heavy rainfall. Toads and newts were believed to spit venom, and the former, supposed capable of living walled up in a rock for centuries, were coveted

by the alchemists for the jewels they were said to carry in their heads. As for the salamanders, all inhabitants of temperate localities, wonderful accounts have been given of their indifference to heat, and of their presence in such resorts as the craters of active volcanoes. Fact, however, is often just as romantic as fiction, and the true life-histories of these creatures display features as marvellous as any invented by the early naturalists.

Living Batrachians are divided into three orders or divisions,—the *Anura*, or Tailless Batrachians ; the *Urodela*, or Newts and Salamanders ; and the *Apoda*, or Limbless Batrachians.

Certain frogs are entirely aquatic, and of these the Clawed Frogs, *Xenopus*, which are confined to South and tropical Africa, have proved so hardy as to have become universal favourites in the aquarium. A life afloat has developed the hind feet of these frogs into super-paddles, the webs between the toes, which are capped with sharp claws, having become so exaggerated that each foot resembles a half-opened umbrella. Further, as a result of thousands of years of total immersion succeeding generations of clawed frogs have developed highly sensory tubular patches on the skin which are believed to pick up the vibrations of the surrounding water, and thus apprise them of approaching danger. Like all purely aquatic frogs and toads, they have no tongue.

The clawed frog will live for many years in a bowl of

water kept at the temperature of an ordinary living-room if fed on a diet of worms and raw meat. The possibilities of escape need give its owner no anxiety as it never comes ashore, save under compunction of excessive drought or famine, when it may be tempted to make a desperate overland journey in search of more suitable quarters.

These frogs have been induced to breed in this country once only,—at Cambridge. Pairing normally begins in the South African spring, although earlier in northern latitudes. At Cambridge their aquarium was kept very cool for a month, and was then warmed on the approach of their spring, and a few seasonable showers simulated by means of a shower-bath. The male frogs, evidently feeling quite at home, broke their years' silence by giving vent to a love song, resembling the ticking of a watch, and audible at not more than three or four yards' distance. In due course eggs were deposited singly on stones and water plants, and two days later the tadpoles emerged. In the course of a week two long barbules developed on either side of the head, just at the corners of the mouth. By the time the tadpoles were some 4 inches in length the barbules, which act as balancers, were half the length of their wearers. These balancers are highly sensitive, and although at first are mere developments of the epidermis, are later directly connected with the tadpole's brain,—such as it is. Like many other tadpoles, that of the clawed frog is provided on its undersurface with



THE CLAWED FROG TANK.

Facing p. 196.]

a sucker by means of which it anchors itself to any convenient object when it desires to rest.

The Pipa or Surinam Toad, *Pipa americana*, of the West Indies and Northern South America is something of a rarity but has been kept, and induced to breed in the London Zoo. "Child welfare" takes strange forms amongst frogs and toads. Some coil the eggs round their hind limbs, others carry them in their mouths, whilst others again broadcast them on the waters, or attach them to aquatic plants. The mother pipa goes one better, and carries the eggs about upon her back. The eggs are first extruded in a frothy mass, not unlike our common frog-spawn, but are later spread over the back of the mother by her consort. Her spongy skin at the breeding season undergoes a curious development, and becomes so yielding that each egg, enclosed in a fairly tough shell, sinks into a little pit or pocket. As soon as the eggs hatch, their shells are forced upwards and form a series of little caps or lids covering the pits. Thus secure from foes the tadpoles undergo the usual metamorphosis without entering the water, and presently emerge as perfect miniature replicas of their parents.

The mother having rid herself of her seventy odd young,—a very small family for a toad,—rubs off the ragged remnants of their skinny cradles against any convenient object, and looking once more comparatively presentable, returns to the water.

The adult pipa is a strange and unprepossessing

creature. Its head is flat and triangular in shape ; its eyes are minute, and the digits of its fore-limbs terminate in star-shaped fleshy appendages. Flaps of skin are also situated on the upper lip in front of the eyes, and at the angles of the mouth. The toad is entirely aquatic, coming ashore only at the breeding season when the male indulges in vocal efforts scarcely rivalling those of its relative the clawed frog. Whereas *Xenopus* has teeth in the upper jaw, *Pipa* is quite toothless.

It is customary to regard modern animals as being small in size compared with their prehistoric ancestors. This is certainly true in the majority of types, but does not apply to all. In the Batrachians, for instance, a few extinct forms such as the Labyrinthodonts rivalled the largest known crocodiles in bulk, but the frogs and salamanders of to-day are quite as large as their ancient ancestors, and appear to have changed but little since Eocene and Oligocene times. Two kinds of living salamanders may fairly be acclaimed as "giants," and fully equal the monster whose fossil remains were brought to light by one Scheuchzer in 1726. Its skeleton, now in the museum at Haarlem, was labelled "fossil man"—"Homo diluvii testis,"—from which it may be gathered that comparative anatomy was in 1726 still in its infancy. This "fossil man" measured a yard and a half.

To-day may be seen in most large public aquaria salamanders up to 5 or 6 feet in length. The best

known is the Giant Salamander, *Megalobatrachus maximus*, of China and Japan, a creature which frequents mountain streams from four to six hundred feet above sea-level. Its eyes are minute and scarcely discernible amongst the numerous tubercles with which its head and body are covered. The enormous



GIANT SALAMANDER.

mouth, curved in an expansive but quite unmeaning smile, can open and close with surprising rapidity upon unwary fish and crustaceans.

The first specimen was discovered in 1829 and brought to Europe alive. Before its death fifty-two years later it had grown from 1 to 3 feet in length;

a rate of growth which goes to prove that the large specimens measuring over 5 feet must be at least a century old. Since that time many specimens of this spartan batrachian have been brought to Europe and America and all have done well. One that lived in the Amsterdam Aquarium for over forty years, bred there, the young being successfully reared to maturity. The eggs were deposited in the form of a long rosary-like chain, encased in a gelatinous envelope. During their infancy the young salamanders are provided with long external gills, which disappear with age, the fully adult salamander having to make periodic visits to the surface of the water to obtain its supply of air. The sight of the giant salamander is, of course, extremely feeble and it relies upon its unsuspecting prey approaching to within striking distance, which it gauges by the vibrations in the surrounding water.

Sligo's Salamander, *Megalobatrachus sligoi*, which rivals the last mentioned in bulk, is distinguished by its flatter head and smoother skin. The first specimen known appeared in 1922 out of a burst drain-pipe in the Botanical Gardens at Hong-Kong after a torrential rainfall. The creature, now an inmate of the Zoo aquarium, was probably introduced into Hong-Kong from the mainland.

The giant Oriental salamanders have a near relative in the smaller Hellbender, *Cryptobranchus alleghaniensis*, of North America. It is a dark brown, rather shapeless beast, and bites savagely when handled,

although this scarcely seems to justify quite as lurid a name as that by which it is known in America. Largely omnivorous, it is particularly addicted to crayfish. It attains a length of 2 feet.

The Mud Puppy, *Necturus maculosus*, of the Eastern United States is brown in colour with black spots, and with large delicately shaped external gill-tufts of a vivid crimson set on short thick stalks,—organs in marked contrast to those of the adult Hellbender in which the presence of the gills are only revealed by an almost invisible longitudinal slit. The mud puppy has short stoutish limbs, each provided with four digits, but which are not much used, the animal progressing chiefly by means of eel-like movements of the body. It is of sluggish disposition, coming forth from its various retreats only at night when it hunts for the worms and crustaceans upon which it lives.

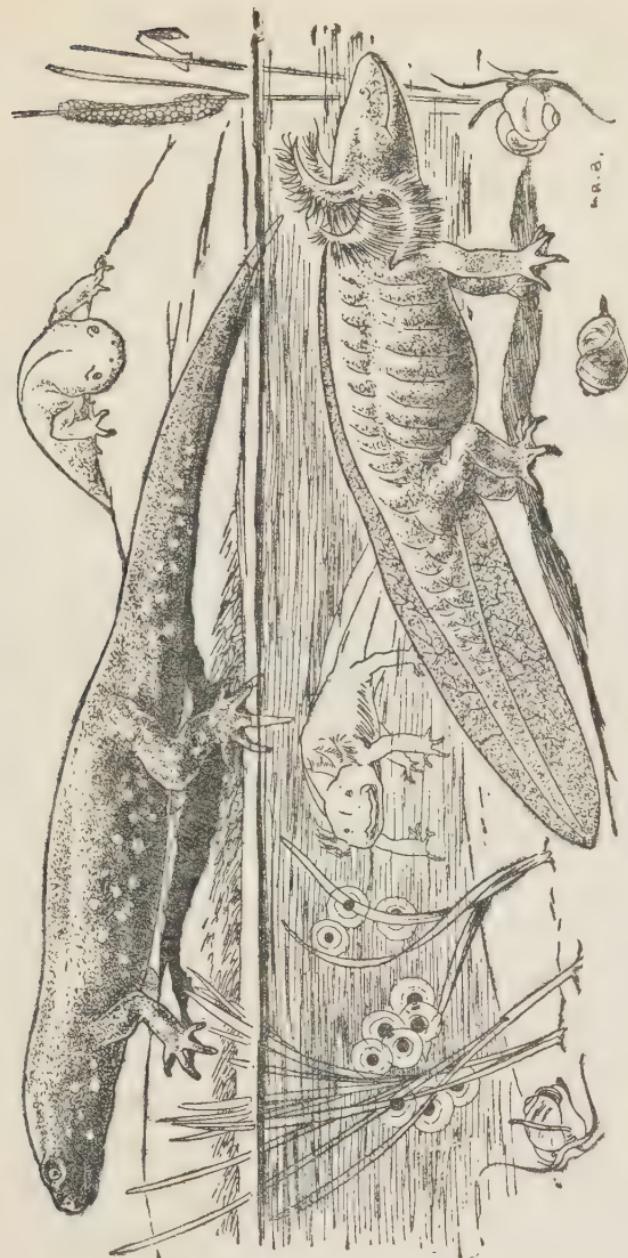
The Proteus, *Proteus anguinus*, is a blind, eel-shaped salamander with external gills and degenerate limbs, the front pair bearing three and the back pair only two toes each. It is a cave-dweller, living in complete darkness in the subterranean lagoons formed by the River Poik in Jugo Slavia, where it plunges underground and passes through a series of vast caverns. Proteus is of a deathly white colour and is totally blind, the eyes only being visible in its quite young stages when the hind limbs are toeless stumps.

This degenerate salamander is remarkably hardy. Specimens have been kept in dark tanks at the Zoo for

very long periods and have proved capable of fasting for years on end. Cold clear water and darkness are all that this strange creature demands in order to "enjoy life." If exposed to the light of an ordinary aquarium, its skin, which is as sensitive as a photographic plate, will turn black.

The Siren or Mud Eel, *Siren lacertina*, of North America has no hind limbs. When young it displays three external gill-tufts on either side of the neck, but as it approaches maturity they disappear, as though the animal had thoughts of becoming a terrestrial salamander. Called siren from its habit of sitting in the water with the head and front part of the body exposed, it haunts shallow ponds and ditches where it feeds chiefly on frogs.

The Axolotl, *Amblystoma tigrinum*, originally a native of Mexico, is bred in large numbers in captivity in Europe and the United States. Outwardly it is a clumsily built tadpole-like creature some 6 to 8 inches in length, black or white in colour, and having on either side of its thick bull-shaped neck a series of long gill-tufts. Under certain special conditions it turns into a salamander. For many years the perfect form was known in the United States, but it was never associated with the axolotl of Mexico,—the two being regarded as quite different animals. Their relationship was established about fifty years ago when some axolotls, received in Paris from Mexico, there laid eggs which in time gave rise to creatures with external gills and



AXOLOTL (*Ambystoma tigrinum*).

fins just like their parents. The water in their tanks having been allowed to slowly evaporate, these axolotls lost their gills and fins, developed eyelids, and finally left the water and revealed themselves as land salamanders identical with the well-known salamander, *Amblystoma tigrinum*, of the United States. In short, if allowed to spend their whole life in their watery nursery, the axolotl is perfectly willing never to grow up. It is one of the few examples we have of an animal breeding in the larval condition.

Recent researches have cast further light upon this remarkable case of arrested development. It has recently been established that axolotls can be, to use a vulgarism, "gingered up" by injections or meals of thyroid gland or pituitary gland. Indeed, a single meal of ox or sheep thyroid will, within a month, force an axolotl to renounce the water and develop all the attributes of a perfect salamander.

Most of the axolotls living in European aquaria are descendants of the few original pairs which bred in Paris.

CHAPTER IV

AQUATIC MAMMALS

THE aquarium should, strictly speaking, embrace everything—plant or animal—that spends the major portion of its life in the water. It follows that certain thoroughly aquatic mammals should form part of the collection of the ideal aquatic zoo. Nearly all such animals, however, apart from making a deafening noise, invariably foul the water, which, being circulated throughout the tanks, soon proves fatal to the other occupants of the aquarium. Where the water can be pumped direct from the sea, and each tank enjoys a separate circulatory system, aquatic mammals have been kept from time to time in captivity with varying success.

The old Westminster Aquarium at one time exhibited a mermaid alive, the lady's fore-part being provided by one of the finest swimmers of the period. The London Zoo and the New York Aquarium, with a greater regard for the truth, later contented themselves with showing those curious animals which are believed to have given rise to the mermaid stories. These, the

vegetarian Manatees or Sea Cows,—grotesquely human-looking creatures, especially the females, which have very large breasts,—are much given to posing waist high out of the water. The New York Aquarium, with its fine position close to the sea and unusual transport facilities, has kept several specimens at various times, whilst a half-grown individual lived for several months in a heated floor pool in the London Zoo's reptile house.

The White Whale has occasionally been shown in aquaria, but with less success than that attending recent efforts to keep porpoises in captivity. At one time the New York institution showed some Bottle-nosed Dolphins, whilst Brighton during the past thirty years has exhibited a few specimens. One lived for nearly two years.

The late lamented "Percy"—a Common Porpoise, caught off Brighton in a herring-net—was typical of his race. He showed great intelligence and inquisitiveness, and learnt to take food from the hand after only a fortnight of confinement. He consumed thirty pounds of fish a day, and during his few months of public life put up a non-stop swim, covering over one hundred and eighty miles in every twenty-four hours. He died of heart failure and subsequent drowning.

The members of the whale family, apart from demanding enormous tanks, present another very serious problem for the aquarist. So great is the heat radiated



Facing p. 206.]

THE SEA LION TANK.

from their bodies, that unless special provision is made the water of their tank becomes too hot to be supportable.

This closes the list of purely aquatic mammals shown in aquaria. The semi-aquatics include a large number of widely contrasted animals—polar bears, otters, beavers, seals, and sea-lions, and some have been shown under water with charming results.

The Sea-Lion is a popular aquarium exhibit,—until he falls foul of the authorities, which he invariably does, sooner or later. Take the case of "Roary," the star performer of a famous troupe. Roary spent some weeks in every year "resting" at an aquarium. One year he was the guest of the Amsterdam Aquarium, where all went well until one morning the curator found every tank either completely devoid of fish, or filled with the dead and mutilated. The explanation came when Roary was discovered shockingly inflated, sleeping off the effects of his orgy outside one of the storerooms. He had climbed out of his aquarium, forced his way into the service gallery, and visited each tank in turn, eating until gorged, and then killing and maiming from sheer sport.

The following year Roary went to the Brighton Aquarium. Upon a certain afternoon during his stay there the adjoining concert hall was packed with an expectant audience gathered to hear a world-famous singer render the "Lost Chord." Few can hear the song without some emotion. Roary certainly could

not. He held out for a few bars, and then drowned voice and organ in a salvo of raucous barks.

He finished his holiday in the sea-lion pond in Regent's Park.

A NATURALIST AT THE ZOO

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"George" ... Southern aspect.

Dessert

In his young days.



... George is not a strict vegetarian.

R. Brightwell

CHAPTER I

THE MAN-LIKE APES

IT is generally admitted that in structure and intelligence the apes, which in the Regent's Park menagerie are always represented by a number of chimpanzees, orang-utans and gibbons, and occasionally by a gorilla, differ but slightly from certain inferior races of *homo sapiens*—the flower of creation. As such they should command our fullest sympathy. But though they are more akin to our highly civilized sophisticated selves than any other animal, representing the last milestone left behind us on the road towards perfection, they are often ridiculed and even abused by their more fortunate relations who call on them at the Zoo. The time however will probably come when the inhabitants of a contented, war-free, strike-free world will look at the human remains of the twentieth century, and marvel at their comparatively imperfect development.

The apes enjoy a man-like structure which is specially remarkable in the young animal, where the strong ridges of the forehead which characterize all the adult specimens, with the exception of the gibbons, are only feebly developed. One of the most obvious differences between the apes and man lies in the much greater length of the arms of the former compared with that of their legs, upon which

they are capable of supporting themselves in a more or less upright position. The apes' feet are as subtle as their hands and are capable of acting as grasping organs, as are, as a matter of fact, those of the newly-born human.

The chimpanzee, an inhabitant of the forests of Central and West Africa, is characterized by its very large ears, its comparatively pale skin, its well-defined eyebrows, and its long black hair which is disposed in great profusion round the face.

Of late years great strides have been made in the study of the chimpanzee's habits and mental equipment in captivity, yet little is still known of its life in the wild state. According to the few reliable authorities who have visited the "chimp" at home, he elects to live in small family parties, hovering twixt tree-top and the ground by day, sleeping aloft at night. At sunrise and sunset he sings his matins and evensong, which may be described as a series of hoots and unearthly howls. The chimpanzee is a bundle of contradictions, for this nervous highly-strung creature, which elects to live a more or less nomadic tree-top existence, quickly acquires under sympathetic tutoring better manners than are often to be observed in a West-end restaurant, and is far more responsive to the demands of civilization than are certain tribes of savages that disport themselves to this day on the banks of the Amazon River. As a babe or growing youngster he is a charming companion, but as he grows up he becomes not only savage and morose but with advancing years less and less intelligent.



L. R. Brightwell

In the development of their brain chimpanzees vary individually to a very great extent—like the members of the human race, from which they differ in that their reasoning powers are at their highest development at the age of about seven years, just prior to attaining maturity.

Several of the Zoo chimpanzees have distinguished themselves from the intellectual standpoint. Arthur, a native of the French Congo, understood many words even when spoken by complete strangers, and he would immediately recognize his friends amongst the crowd of visitors that thronged round his enclosure. He had been taught to feed from a plate with a spoon and fork, and to pick out the key of his cage from a bunch containing a large number. He would dress himself, an accomplishment which however, did not require teaching. One winter's day his keeper, thinking he might possibly be feeling the cold, threw into his cage a pair of old overalls, expecting the ape merely to cover himself. Arthur, however, immediately seized hold of the apparel and put it on in the orthodox fashion. After that he was given a large assortment of clothes to wear, which he always put on without assistance.

Micky, who lived for twenty-five years (1898-1923) in the Zoo, where he arrived at the age of two, was a great character. Although amiable when quite young he soon developed a temper. He was specially cantankerous on bank holidays when a policeman was posted inside his house to control the crowds. At the sight of a member of the "force" Micky would howl with rage, his dislike

for the "man in blue" being due to the fact that on a certain bank holiday, when he was still quite an infant, a policeman on point duty passed the time of day making grimaces and shaking a truncheon at his poor relation. For years after this he would express his hatred and contempt for any representative of law and order that entered his house by shrieking, and spitting at the glass pane which separated his cage from the public thoroughfare. Micky allowed the grievance to prey upon his mind, and with advancing years he would even show marked signs of displeasure at the sight of any uniformed person, and it was not until the winter of 1914 when large numbers of military visitors, in every conceivable type of uniform, passed through his house, that the insult inflicted upon him so long ago was entirely forgotten.

A chimpanzee remarkable for its intelligence was one named "Consul" who many years ago performed at the London Hippodrome. Of his public performance the most interesting feature was the skill with which he rode a bicycle, the steering of which around tables and chairs, on a comparatively small stage, implied a degree of mental adjustment with which even the apes are not usually credited. One night, when performing in Paris, Consul introduced on his own initiative a number of additions into his "turn" in imitation of a comedian who had entertained him the previous afternoon at the Folies Bergères.

Equal in intelligence to the chimpanzee is the gorilla of West Africa, a more powerful and bulky

animal, which attains a height of $5\frac{1}{2}$ ft., and a weight of 35 stone. With the former ape it agrees in the black colour of its hair and the presence of eyebrows on the forehead, but differs in its longer and stronger arms, its thicker neck, its longer nose, its shorter upper lip, and its smaller ears.

The gorilla does not thrive in confinement unless treated exactly like a human being, and the few specimens that have from time to time been exhibited in zoological gardens have, with one or two exceptions, been morose and unresponsive and have only survived a few months of captivity. In 1918 a young gorilla called John came into the possession of Miss Alyse Cunningham who kept it in her flat in Sloane Street where it was treated as one of the family. Consequently it lived for many years a contented and civilized life. Another gorilla acquired by the same lady five years later and kept under similar conditions died only quite recently. One reason for the good health of these gorillas is to be found in the fact that they were both acclimatized to the normal temperature of a dwelling-house and were taken for walks and drives in practically all weathers. Also that they were never left alone except at night. They washed themselves every morning in tepid water, and were taught to be clean in every respect. They would of their own accord go to the bathroom, and at night would get out of bed and return after re-arranging their bedclothes, without appealing for assistance. John was specially well-known to Londoners, as he loved to hang out of the fourth-floor window of

his flat and amuse passers by with his antics. When excited, as he always was when he saw anything that specially entertained him going on in the street below, such as soldiers marching by, he would stand up on his window-sill and beat his chest alternately with either hand at a terrific rate, a habit peculiar to gorillas, and first described by the naturalist-explorer Du Chaillu ; of the many intelligent actions performed by this gorilla, the most remarkable was on an occasion when Miss Cunningham who was dressed for a garden party in a light frock refused to take him on her lap to be nursed. After rolling about on the floor and crying for a few minutes, John got up and fetched a newspaper which he very carefully spread out on the lap of his mistress before attempting to climb up. One or other of Miss Cunningham's gorillas have for some years been exhibited during the summer months at the Zoological Gardens in a large cage which they share with human playmates. They come to the gardens for the day, travelling to and from their home in a taxi-cab.

The Orang-utan—a name of native origin meaning “ wild man of the woods ”—makes his home in the forests of the swampy lowlands of Borneo and Sumatra, where his exceptionally long powerful arms enable him to climb the highest trees, and to form the so-called nests or platform shelters under which he sleeps at night. The face of the orang has a somewhat bluish tint, and is provided with a very small flat nose whilst the ridges over the eyes are less developed than in the chimpanzee and gorilla. The forehead is much elevated and the ears, which



ORANG-UTAN.

Facing p. 218.

are very small, are very human in shape. The cheeks of the adult male are surrounded by a pair of enormous flaps of skin, whilst the throat forms pouches communicating with the creature's larynx which become inflated with air at more or less regular intervals. The orang, although a sluggish creature with none of the nervous vivacity of the chimpanzee, is always the most popular exhibit in any zoological gardens as he is invariably the greatest laughter-maker in the menagerie. Murphy, a half-grown specimen that lives in an outdoor enclosure communicating with a small, slightly warmed cage, is the recognized buffoon of the London Zoo, his antics such as standing on his head, turning somersaults, wearing paper bags on his head, and using the dangling rope-ladder in his cage as a sort of hammock, causing great hilarity. On bank holidays he is always the recipient of many gifts, edible and otherwise, which early in the day are much appreciated, but which later, when he is slightly bored with his many admirers, and his appetite has been satisfied, are rudly thrown back at his would-be benefactors. On one occasion he was observed to accept a vessel containing an ice-cream, which he proceeded to pour over his head, consuming with obvious enjoyment the melted parts which slowly trickled over the regions of his mouth. He once appropriated a pair of gloves and wore them for the greater part of the day. Murphy was allowed out in his enclosure one day last winter after a heavy snowstorm. He was delighted with the snow, which he picked up in large handfuls and,

after tasting it, threw at the visitors outside his cage.

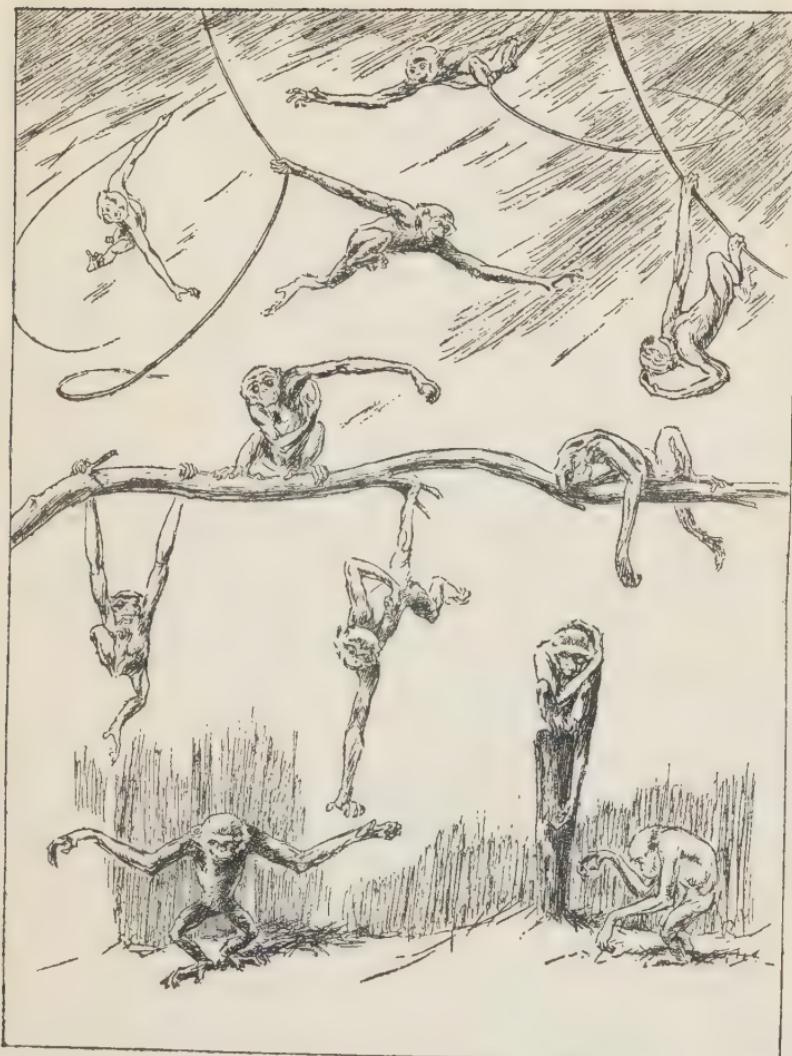
Some years ago on a foggy winter's evening Jacob, a splendid full-grown orang-utan, exhibiting the enormous cheek flaps and throat pouches which characterize the adult male, broke out of the old Ape House and climbed a neighbouring tree, where, answering his forest instincts, he built a nest platform of boughs and twigs and settled down for the night. Some keepers who were out ratting heard a noise in the neighbourhood of his house and soon ascertained that the giant ape had broken loose. It was found that the animal had made a large hole in the strong wire-work of his cage, squeezed himself through it, and then climbed to the roof of the house, where, with a flower-pot appropriated from the window-sill of the service corridor, he broke a way out through a skylight. The fog and darkness made it difficult to attempt to recapture him before the morning, so a number of men armed with rifles, ropes, nets and provided with flares, kept an all-night vigil. A successful offensive was undertaken at dawn, when a fire-extinguisher was brought into action and the ape returned to his cage through the hole he had made in the roof.

An interesting account of the popular orang-utan, Mollie, which lived for many years in the Melbourne Zoo, has been given by Mrs. A. Osborn. Brought to Australia when only a few months old, this ape lived in a cage in the gardens for over twenty years. The manner in which Mollie prepared for her night's rest was an object-lesson in the art of bed-making.

A number of bags were spread out on the floor of the cage, every suspicion of a wrinkle being smoothed out. More bags were then rolled up into a bundle, and placed at the head of the bed to form a pillow ; finally she wrapped herself up in a rug, and stretched herself out in preparation for a night's sleep. She was very vain and like most children delighted in dressing up. An umbrella gave her special pleasure, and she was constantly on the look-out for an opportunity to snatch one from the unsuspecting visitor. On attaining her objective she prepared an elaborate arm-chair made out of the bags and rugs provided for her bed, and on it reclined at her ease for hours under the open umbrella. The Melbourne Zoo authorities had no objection to the ape occasionally indulging in a cigarette, which, provided the brand was an expensive one, was much enjoyed. "Gaspers" were indignantly thrown away after the first few puffs. Mollie lighted the cigarette herself, this accomplishment necessitating the lining of her cage with iron, in order to render it fire-proof. One one occasion this remarkable ape succeeded in picking the lock of her cage and escaping into the gardens. The public were much alarmed, but not more so than Mollie for as soon as the overseer appeared on the scene she immediately rushed towards him for protection and allowed herself to be led back to her cage.

The least intelligent of the apes are the acrobatic gibbons of the forest regions of South-eastern Asia, of which there are about twenty different species. They may be distinguished from the other members

of the primate order by their much smaller size, their more delicately shaped bodies, and the extraordinary length of their slender arms. The largest living gibbon attains a height of 3 feet, but the majority seldom exceed 20 inches. Although less man-like in appearance than the chimpanzee, the gorilla, or the orang-utan, the skull of the gibbon approaches the human type more closely than that of any other animal. In captivity these thoroughly arboreal creatures can only be observed to advantage when kept in enclosures sufficiently large to allow them to give an unrestricted display of their amazing agility. When on the ground the gibbon invariably walks in an upright position, its long arms being usually bent and held dangling at an angle just below the level of its head. The most active member of the family is the common Agile Gibbon, which when swinging from bough to bough is capable of clearing forty feet at a single leap, and has frequently been observed to capture birds on the wing. The Siamang, which is specially remarkable in its possession of a throat-sac that can be inflated at will, is the largest and least acrobatic of the gibbons. It has the power of producing the most piercing howls, which can be heard on a quiet night at considerable distances. Nothing can be more suggestive of lurid murder in progress than the night song of the Siamang, and on one occasion a Zoo specimen inspired the policeman on his beat outside the gardens with glowing visions of promotion—fortunately unfulfilled.



GIBBON ACROBATICS.

CHAPTER II

THE BABOONS

BABOONS are characterized by their long dog-faced snouts. They are confined to Africa and Arabia, and apart from the man-like apes are the largest members of the monkey tribe. The most powerful baboon is the stump-tailed mandrill of West Africa, who is provided with teeth worthy of a tiger, and a temper to match. The adult creature is gorgeously coloured, its face consisting principally of a vivid scarlet snout, garnished on either side by a fluted cheek of the brightest azure blue. A description of its back-view may perhaps be best effected by remarking that short-sighted visitors are on occasions in some doubt as to just which end of the baboon is the facial portion. In his guileless youth the face and tail-end of the mandrill are black, and it is only when adolescence descends upon him that these parts flush with the glories of a Turner sunset.

Mandrills move about in large colonies, and persuade most other animals, including the lion, to give them the road. These colonies have been known to wage war upon native troops and to have successfully defied the opposition, not merely by attacking in mass formation but by rolling rocks and boulders down upon the enemy. George, the

Zoo favourite, has a few friends who are allowed to caress him, but for most members of the human race he has the most profound contempt and dislike, and his long incisor teeth are perpetually set in a murderous snarl, even when accepting the most appetizing of dainties from his admirers. He is fed mainly on a fruitarian diet, but he also relishes mice and sparrows, two unofficial exhibits in the gardens, which have now learnt to avoid his cage. In his native haunts the mandrill does much damage to plantations, and this tendency to be a public nuisance is apt to lead to his ultimate extermination. In the meantime he forms an arresting and entertaining exhibit in any zoo, where he rivals the showiest of colour schemes in the tropical aviaries or aquaria.

The Chacma or Pig-tailed Baboon, an inhabitant of East Africa, is a commoner but less striking form, being more or less uniform dark grey in colour. It is represented in most zoological gardens and even travelling menageries, being the best tempered of all the baboons. It makes a popular exhibit owing to its humorous, if not always engaging, manners. The way in which a specimen ended its existence in the Melbourne Zoo is worth recording. The baboon was not kept in a cage, but was chained to a pole about twelve feet high, which was surmounted by a small platform and fixed in the open. The chain attached to a collar round the monkey's neck was long enough to enable the animal to climb up and down the pole. Now this baboon loved to "show off" and therefore in order to concentrate

the attention of the public upon himself would turn somersaults, and perform various acrobatic feats. Having collected a large crowd he would climb the pole on to the little platform, and then, holding the chain in one hand about six feet from the collar, would proceed to jump into space, coming down dangling at the end of the chain. There he would hang absolutely still and rigid, with legs stretched out, simulating death. But all the time one hand was holding on to the chain just below the collar, thus preventing strangulation. This act never failed to horrify spectators, who when seeing this performance for the first time, were genuinely deceived and would give utterance to screams of dismay to the huge delight of the performer of this simian "grand guignol." When the monkey thought he had created a sufficient sensation he would suddenly come to life and wave his chain triumphantly in the air. One unfortunate day, whilst enacting this trick his hand slipped from the collar, and it was a really dead baboon that swung to and fro from the end of the chain.

An hour spent leaning on the parapet of the forty foot high Monkey Hill in Regent's Park, which with its pinnacles, plateaus, precipices, caves, and drinking pools reproduces a corner of baboon-land somewhere in Arabia, will reveal the home-life of the Sacred Baboon, an inhabitant not only of Arabia but also of Abyssinia and the Soudan. The face and hind-quarters of this very typical baboon which with its stubby hands and feet is better adapted for scrambling on rocks than climbing trees, lack the



LIFE ON THE MONKEY HILL.

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prismatic hues of its relative the mandrill, being tinted a uniform pink or scarlet. The males are characterized by their huge square-cut manes or capes of long coarse hair, covering the neck and shoulders.

The Sacred Baboon is easily the most dignified and impressive member of the baboon family, and centuries before the Christian era was worshipped by the ancient Egyptians. In certain old Egyptian cities thousands of baboon mummies have been unearthed recently, the mummified animals all exhibiting the characteristic resting pose—seated, with the hands placed upon the knees. This stately monkey figures largely in mural paintings, and on monuments, which all bear witness to the fact that his early masters, more successful than the modern trainer, taught the creature to play the useful rôles of watch-dog and fruit-gatherer.

The ninety-odd tenants of the zoo's Monkey Hill include sacred baboons of both sexes, and all ages, from venerable tribal leaders to mere "toddlers," who may be observed riding "jockey-fashion" on the backs of their elders. As with most baboons the family motto appears to be "united we stand," the inhabitants of the "hill" eating, sleeping, playing, and giving battle always in mass formation. Although a formidable crowd they are on fairly good terms with their keepers, who go among them armed with nothing more deadly than a stable broom. This great assemblage of baboons in all probability marks the largest "round up" of such animals since the days when they were

requisitioned for the Roman arenas to act as gladiators. Their captors organized the construction of some scores of huts, with trap-doors, skilfully camouflaged with bushes. The huts were baited with a variety of food, and the baboons once inside were detained by the sudden pulling of a cord, whereby the hunter stationed at some distance suddenly dropped the door. The baboons were then lured into cages, and these in turn loaded on the backs of camels. Some days' trek across the desert to the rail-head, a long train-journey, a sea-voyage, and a lorry ride, eventually came to an end at Regent's Park. Kind treatment, good food, warmth, and artificial sunlight on dull days, soon reconciled the baboons to the Zoo's copy of Arabia in somewhat restricted form, and to-day not even the rigours of an English winter can damp the buoyant spirits and tireless energy of this unique colony.

CHAPTER III

MONKEYS

MONKEYS present an endless array of structure and adornment. Some are ornamental, others are hideous. Although most are intelligent, a few are stupid. There are silent monkeys, chattering monkeys, and howling monkeys. They may have exceedingly long tails, which in the American forms are prehensile and act as a fifth hand, or they may have no tails at all. Many of the Old World monkeys have cheek-pouches formed by folds in the skin, which may act as receptacles for the storage of food, but when empty lie flat on either side of the face. The limbs of ordinary monkeys vary greatly as to length, but the arms are never longer than the legs as in the man-like apes. Members of the greater number of the several hundred species known have at one time or other been inmates of the Regent's Park monkey-house.

In recent years the monkeys at the Zoo have greatly improved in health as a result of their being given access to the open air all the year round. In the old days the conditions of housing of our poor relations were determined solely by considerations of temperature. This was changed

when Dr. Chalmers Mitchell, the present secretary of the Zoological Society, was able to show from the records of longevity of the monkeys and other animals, that had inhabited the gardens over a prolonged period, that the life of those kept in heated houses at a uniform temperature was shorter than in the case of those exposed to fresh air, and a varying temperature. In the future the Zoo monkeys will not only have access to the open in winter as well as summer, but their indoor apartments will be furnished with sunlight lamps transmitting the ultra-violet rays which in recent years have been proved to be of such benefit to sickly and rickety children.

The commonest form of monkey seen in captivity is the organ-grinder's monkey—the Rhesus Macaque of India, and at one time over a hundred of these comic creatures were exhibited in the huge outdoor cage opposite the elephant house, where they presented a spectacle of riotous high spirits, especially in the summer time, when they were to be observed swimming, splashing and pushing one another into the water of the pond in their enclosure. Certain natural history books say that monkeys cannot swim ; but a visit to the Zoo during a heat-wave would soon convince the authors of such statements to the contrary.

Gifts of rhesus macaques are continually being offered to the Zoo, but are seldom accepted. These monkeys are affectionate enough when young, but even then they have a way of making life a little too full of incident, with the result that their owners,

after keeping them only a few days, are on their bended knees before the Zoo authorities, begging them to relieve them of their newly-acquired pets. One large specimen who had smashed a kitchen full of crockery, turned on all the taps of the gas cooker, and then bitten its owner, escaped into Regent's Park from the cab in which he was being brought to the Zoo. There he took up his abode in a tree, and defied all efforts to capture him for over a week.

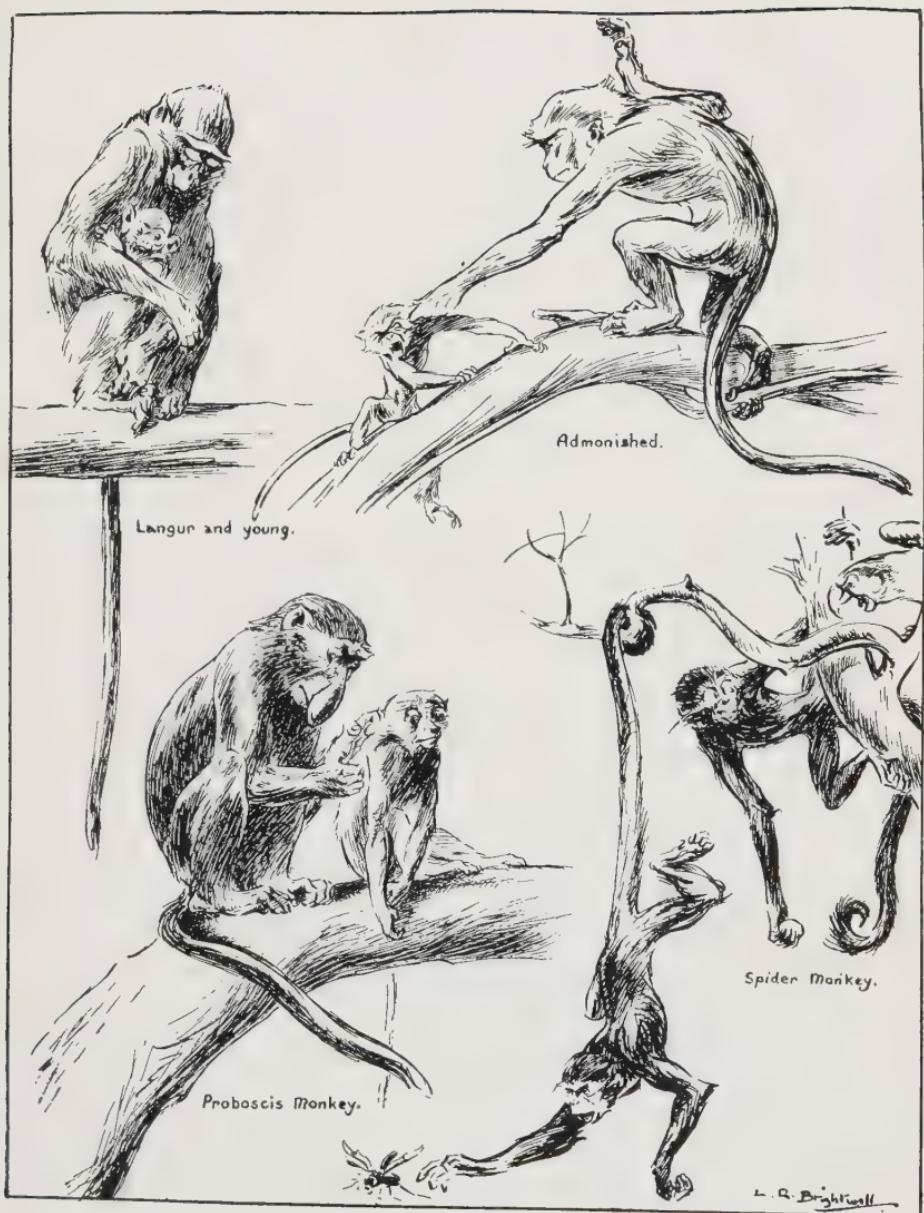
Another macaque usually in evidence in Regent's Park is the so-called Barbary Ape of Gibraltar, a monkey which from its peculiar association with man is in certain ways one of the most interesting beasts that ever ran on all fours. The exact origin of the creature is uncertain. Some authorities declare that he was imported from North Africa, while others are equally certain that he is indigenous. Since the British occupation of the Rock these monkeys have been more or less under army discipline. For years a fairly exact census of the monkey population was kept, and at times when the animals became too assertive, direct action was taken.

The welfare of the monkey community is not neglected, and visitors to the Zoo some years ago may remember a peculiarly large and ferocious old male who had been banished from the Rock by the military authorities. This unlovable veteran was a kind of simian Landru, for he had developed in his crabbed old age a horrible penchant for murdering females of his own kind, and nearly succeeded in wiping out the monkey populace,

which for so long had been a merry feature of the gateway to the East.

The big, slender, long-limbed, long-tailed, silver-coated Sacred Langur of Northern Indian is one of the most handsome, liveliest and most mischievous of all the members of the monkey tribe. A number were some years ago sent to many of the European menageries at the special request of the native worshippers, for even the devout Hindu found this animal too great a trial to endure any longer. In the monkey-temple of the city of Benares, where the langurs reigned supreme, undaunted by the deafening music of gongs and horns, they haunted every corner of the sacred edifice. Not contented with fouling the floors and vestments they extended their activities to the surrounding streets, where no true believer dared to dispute their right to rifle shops, raise their families in private dwellings, and impose every kind of indignity upon the populace at large. At last, tired of having their turbans snatched from their heads and their noses pulled, the priests and dignitaries appealed to the British Government, and with thankfulness saw some thousands of these pampered and revered animals caught, caged, and removed to other spheres, where their peculiar brand of humour would be more appreciated.

In 1912 a young Capped Langur, so-called from the raised crown of hair on its head, was born in the gardens. The newly-born monkey's head, which was so enormous as to suggest water on the brain, was quite bald and the colour of its face differed



MONKEY STUDIES.

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from that of its parents in being flesh-coloured and not black. It was not until it was over two months old that the hair on the head began to grow and that the face assumed the dark complexion of its parents. In the following year the mother of this youngster produced another offspring, and her affections were naturally transferred from the first-born to the new arrival, much to the disgust of the former, whose displeasure was expressed so actively as to necessitate its removal to separate quarters.

The Holy Langurs of Asia are replaced in Africa by their allied, and even more striking relatives the guereza and king monkeys. These, like the American spider-monkeys, are more or less without thumbs, which are represented by mere knobs, or tubercles. The thumb it is supposed gradually atrophied from disuse, these creatures employing their hands as mere hooks or grappling irons. The lack of this digit has one drawback from the monkey's point of view, for the guerezas and king monkeys are unable to join their thumbed relatives in the favourite sport of "beating the home coverts." It may be explained that monkeys, like most animals, are passionately fond of salt, and it is the saline particles which clog their fur, and not vermin, that is the reason for that ceaseless search of their own and neighbour's coats. The guerezas and king monkeys are covered with long hair, which hangs down on the sides of the body forming a mantle. They are seldom exhibited in captivity, although their fur which is in great demand, is unfortunately seen only too often in the West-end of London.

The Long-nosed or Proboscis monkey is an amazing creature, which is very rare in menageries, outside Borneo its native land. It is a large slender animal, the person of the male being entirely dominated by his nasal appendage, in comparison to which that of Cyrano de Bergerac was to be regarded as a mere button.

A large number of guenon monkeys from Africa are always on exhibition in the Zoo. They present a great variety of colouring. One species is distinguished by a terrific ginger moustache, whilst another had a little nose of glaring whiteness, set in the middle of a coal-black face. They are all comparatively small and slender, and not very distantly related to the langurs.

The common Green monkey like the rhesus macaque is occasionally seen marooned on a hurdy-gurdy. The Mona and Diana monkeys are two handsome black and white forms, the latter carrying off the prize for beauty by virtue of a sweeping beard. Those that have been kept as pets in this country sooner or later find their way to the Zoo, as a result of their encounters with neighbours, local tradesmen, and the law.

There are few more entertaining creatures to be seen at the Zoo than the very active American Spider monkeys. They are essentially adapted to an arboreal life, as their long tails are capable of being used as grasping organs and are sufficiently strong to enable the animals to hang from the branches of trees without the aid of their extremely long and slender limbs. As a result of constant

use as a "fifth hand" the under surface of the tail has become quite hairless.

The Spider monkeys at the Zoo are gentle inoffensive souls, rather sensitive to cold. Unlike most of the monkeys previously referred to they make charming pets for those who can afford to provide them with a sufficiently luxurious environment. From all accounts they are, however, less docile in their native South American jungles, where huge troops swing through the tree tops, ravaging birds' nests and pillaging the hives of bees and wasps.

Closely allied to the Spider monkey is the little Capuchin, who has been described as looking like a little old man seen through the wrong end of a telescope. From cradle to grave he wears a benign though care-worn expression, which consorts strangely with his clownish caricaturing of a light-hearted human being. He is not amongst the least intelligent of monkeys, as was clearly demonstrated some years ago by a specimen which during an illness had been given a little brandy each morning. On his recovery his brandy ration was naturally discontinued, which so upset the little animal that for days he would attempt to arouse the pity of his keeper, rolling about as if in pain, accompanying his action with heart-rending moans. Like most monkeys he is very fond of insects. The Zoo insects are exhibited in the same building as certain small monkeys, and at one time several big cases in the house were occupied by thousands of stick insects. The insects bred apace and the young ones, escaping

through the perforated zinc covers of their cases, permeated every corner of the building. They swarmed up the wire-fronted cages containing the Capuchins, where the solemn little monkeys would sit for hours on end picking the stick insects from the wires and eating them. As a result when supper time came they showed none of the usual enthusiasm for their official rations.

No creature can be more entertaining or affectionate than the somewhat bulky, nigger-faced Woolly monkey of Brazil, which takes its name from its woolly coat. Unfortunately his extreme affability excites certain visitors to mistaken generosity, and on a crowded day he is liable to receive a multitude of gifts highly detrimental to his well-being, such as pen-knives, sharp-edged pocket mirrors, reels of cotton, tobacco, etc. At the Zoo he is sometimes "chummed in" with such cage mates as wombats, guinea pigs, armadillos, and squirrels, and if at any time there is a little friction it is never the fault of the woolly monkey. The tails of these creatures are even longer than those of the spider monkeys, and form grasping organs of such a perfect kind that they may sometimes be observed accepting gifts and transferring them to their mouths by means of their highly specialized caudal appendages.

A distant relative of the spider and woolly monkeys is known as the Howler from the extraordinary loud volume of sound which it produces as a result of an over-developed larynx. The sounds produced by this creature are so rich and deep as to be heard

at considerable distances. Once the late dealer Hamlyn lodged three of these monkeys in his shop in St. George's Road, near the Tower Bridge. On a certain warm August night with a gentle south-east breeze, the musical trio were distinctly heard at Ludgate Circus—marvellous sounds to hear in mid-London—a love song from Brazil rising above the traffic's sordid drone. When many howlers of all ages take part in a choral concert the effect is ear-splitting. The howler's gigantic larynx is hidden by a huge beard which not only protects the organ from cold but acts as a buffer when two rival baritones fight—all for the love of a lady.

Perhaps the most popular society pet, is the Marmoset, and there are always a few of these little monkey aristocrats temporarily exiled from Mayfair and entertaining the world at large in Regent's Park. All these very active arboreal little creatures are small enough to tuck away comfortably inside a muff, and with few exceptions they are of a bland and cheery disposition. They differ from the other American monkeys in that all their digits with the exception of the big toe terminate in pointed claws and not in flattened nails. There are a very large number of different kinds of marmosets. Some resemble squirrels more than monkeys, the tips of their ears being fringed with long stiff hairs. In a common form known as the Lion Marmoset the neck is surrounded by a mane of long golden hair. Although of delicate constitution, these creatures may live for some years on fruit, insects and eggs, and in captivity they have been

known to make some quite remarkable dietic experiments without experiencing any very disastrous results. One, for instance, that was brought to the Zoo appeared rather listless for the first few days of its tenancy, which was hardly surprising when one learned that just prior to leaving home it had entered its mistress's study, and consumed its own weight (6 ounces) of photographic paste.

Always to be found at the Zoo are various species of Lemurs, four-handed creatures with fox-like heads, which are much lower in the scale of life than the creatures which have been already under review. These "half-monkeys" are found in Africa, Asia, and especially in Madagascar, which is the home of a very large number of different kinds. They are mostly forest dwellers, although the Ring-tailed Lemur, one of the commonest forms, is a mountaineer living amidst rocks and precipices. The ring-tailed lemur breeds freely in the Zoo, where the mother lemur may often be observed carrying her newly-born offspring transversely across the lower part of her body, the baby hanging on to the fur by gripping firmly with its hands and feet, and passing its tail over its parent's back and round its own neck. When about two months old it shifts its position to its mother's back, holding on by clasping her round the neck with its arms.

CHAPTER IV

BEARS

IN captivity the bear has always been one of the most popular of wild animals. Less than a couple of centuries ago, when he was baited with dogs in bear-pits, he contributed largely to the "merriment" of "Merry England." At a later date he was led round the country and made to dance for the delight of the less enlightened section of the populace. To-day he still provides entertainment, but in a different way. Left to himself the bear will keep a crowd happy for hours by the simple entertainment of begging for buns, biscuits or tins of treacle or by engaging in a rough and tumble with his cage companions. Besides, his comfortable appearance, his sumptuous coat, and expressive countenance make an irresistible appeal to our sense of humour. Unfortunately the bear belies his looks, and every zoo in the world can record many instances of bears "going bad" and turning on their cage-mates or their keepers. As cubs they are quite delightful, but as they come of age the "old Adam" in the bear comes to the surface and becomes more obtrusive and menacing with advancing years. Frank Buckland whilst at college owned a bear cub that could sit at table and comfort itself with massive solemnity. When just over two

years old it raided a greengrocer's shop, mauled a postman, killed a dog—and was offered to the Zoo. It was a typical bear. "Never make a pet of a bear" is the maxim of our own Zoo keepers if they wish to live long enough to enjoy a pension. Most bears are largely vegetarian, but they have the make-up of a purely carnivorous animal. They are vegetarian more from force of circumstances than choice, for as bears cannot run fast for long they must rely almost entirely on stealth for their supply of meat. The majority inhabit the colder regions of the world, and as winter approaches not only grow heavy coats but accumulate vast stores of fat. Thus reinforced they often retire underground or hide in caves and for months on end await the return of mild weather in a state of semi or complete torpor. In the spring the she-bear brings forth one or, rarely, two cubs. The he-bear being no family man deserts his wife and leads a gay bachelor life on his own as soon as he suspects the advent of a family. Sometimes, as in the case of the polar bear, the prospective mother retires to the most secluded spot she can find and there, snugly ensconced and buried beneath the snow, brings up her offspring unhampered by the peevish demands of a selfish male.

In captivity in this country one would expect the polar bears to object to our mild climate. Not so, however; for these bears are never as happy during the winter as in the summer, and contrary to the general supposition they enjoy the heat and dislike the cold. During a heat-wave, when even some of the animals from tropical climes are

suffering and seeking the shade, the polar bears will deliberately lie out in the full glare of the sun. In winter when the temperature falls below forty-five degrees they avoid the water, with the result that for several months in the year they present an unwashed appearance.

Common bears are occasionally born and brought up in the London Zoo, but polar bears have never been successfully reared in Regent's Park, the numerous cubs born invariably dying of pneumonia within a few days of their birth. The famous polar bear, Barbara, on several occasions gave birth to one or two cubs, but they unfortunately always died in spite of the efforts made to bring them up. They were sometimes left with the mother, sometimes given to a bitch to foster, and on one occasion they were taken away to be bottle-fed. The result however was always the same, the young cubs dying of pneumonia on the third or fourth day. As a result the theory has been expounded that as the microbes of pneumonia do not exist in the Polar regions, the young bears, unlike most other animals, have no immunity against the disease. In only one zoo—the Milwaukee Zoo—has a polar bear ever been reared from birth. For some weeks before the arrival of the cub in question, the female was removed from the enclosure which she shared with her consort and was accommodated in a small den. She stopped eating three days before the cub was born. On the day of birth the thermometer registered twelve degrees below zero and the mother protected her offspring from the cold by pressing

it against her abdomen and covering it with her paws. Prior to the interesting event straw had been placed in the den, but the proffered bedding was pushed aside, the expectant mother choosing to sleep on the bare boards. On the arrival of the youngster, however, the straw, which had been rejected and placed just inside her den was taken into the inner compartment during the night. She accepted further supplies of straw until she had seven bales in all. Her ability to determine approaching storms was remarkable, it appears, for when bad weather was on the way she would always pack the opening of her den from the inside leaving only a small vent open at the top. In mild weather she would pull the straw down until the opening was practically full-sized. The mother left the den in search of food at the end of a week. The baby at quite an early stage would crawl to the opening of the compartment, but the dutiful parent was always on guard to discourage such attempts, and it was not until the young polar bear was four months old that it was allowed out without being interfered with by its over-watchful mother.

Sam and Barbara soon after their arrival in Regent's Park augmented their popularity by figuring in that select list of Zoo inhabitants that have escaped. The bears chose an early summer morning to take advantage of a faulty lock and wander forth when only workmen and keepers were abroad. Barbara had only gone about a hundred yards when she fell a victim to an attack of nerves and returned home at the double. Sam, more bold, pushed for-



The bath club. - Polar bears.



Tea on the Mappin terrace.



The after-lunch nap.

L. R. Brightwell

BEARS.

ward until he reached a point equidistant between his den and the South Gate turnstiles. There he came face to face with a working man carrying a load of planks. Four twelve-foot planks can make a lot of noise if dropped with sufficient suddenness. It is a moot point whether the man reached the exit before Sam reached his own quarters. At any rate it was the last time that the bear sought to indulge his "wanderlust."

King Henry III kept a polar bear in the Tower, and this animal was the first of its kind to be exhibited in England. The bear was so highly prized by the King that his people were taxed 4d. a day towards its upkeep. It was supplied with a rope long enough to enable it to swim and fish for its food supply in the Thames, a procedure which if adopted at the present day would fail to supply the polar bears with even the meagrest of meals.

The bear is on the whole an intelligent animal, and endless instances have been recorded demonstrating its capacity for associating cause with effect. Zoo bears quickly learn what the public wants, and deliberately cultivate the tricks and poses best calculated to incite a steady fire of buns and biscuits. A bear has a very sweet tooth and will do anything in its power for treacle or honey. In bear-infested districts the telegraph poles must be covered for some eight feet and upwards with sheet iron to prevent the animals from clawing them to pieces in a vigorous but misguided search for the bees suggested by the inevitable humming set up in windy weather.

A large Grizzly Bear in Regent's Park was subject years ago to an umbrella complex, the violent dismantling of such an article giving him extraordinary pleasure. Umbrella mauling became in time such a "grand passion" that he actually devised an "umbrella trap." This animal learnt that the indulgent public, ever willing to help a bear in distress, would utilize the point of an umbrella to push a fragment of bun that had fallen outside his cage just within reach of his paws. The bear invariably grabbed the bun and included the good samaritan's umbrella in his grasp. He always saw that a piece of bun was in readiness—apparently just beyond his reach. The baited trap was not left neglected for long, and the human dupe usually forgot his chagrin at losing his umbrella in the joy of watching the discomfiture of the next victim.

CHAPTER V

THE CAT FAMILY

THE typical cats number about fifty species and range in size from that of a lion or tiger to the domestic form. The range of colouring is equally striking in the many contrasts presented, but, apart from size, all cats are very similar in general structure, mentality, and, as a natural corollary, habits.

The lion ranges throughout Africa and Persia to India, and in prehistoric times roamed at large over the greater part of Europe. No other animal has commanded such universal obeisance, or enjoyed so much publicity, whether in royal coats of arms, or the humbler heraldry of public house sign-boards. His figure is an emblem that has coloured a thousand legends and traditions.

So far as stature and development of mane are concerned the lion is seen to greatest advantage in captivity. In the wild the mane never attains to menagerie proportions, suffering much in contact with the thick undergrowth, and like the rest of the royal animal it is often infested with parasites and mange. The mane is at once an adornment to charm the female and a protection to the throat when two males come to blows on the subject of a wife or a dinner. The probable lease of life of the

lion is about thirty years, although few can attain such an age except in the safety of an up-to-date and scrupulously hygienic zoo.

The lion, because he does not habitually attack man except when under the influence of great hunger, has often been accused of cowardice. Such a charge appears however not to be well founded. According to the late Mr. Selous : " When lions are met with in the daytime they almost invariably retreat before the presence of man, even when disturbed at the carcase of an animal which they have just killed, and when they are presumably hungry. If pursued or wounded, however, they may be expected to charge. I have found in my experience that a far larger proportion of them do charge than any other animal in Southern Africa with which I am acquainted, and as their power of concealing themselves and their quickness and agility in attack are far greater than in an elephant, buffalo, or rhinoceros, I pronounce them to be more dangerous animals to meddle with than any of these. As with men and all other animals, individual lions differ so much in disposition one from another that it is impossible to tell from one's experience of one what the next is likely to do, and I do not consider that any man has a right to say that lions are cowardly beasts because the two or three that he has shot have not happened to show fight."

The fact that two lions killed and carried off twenty-eight white men and an unrecorded number of natives during the construction of the Uganda railway line clearly proves that on occasions the



The Royal nursery.



The Cat and the King.



A bottle baby.



Some feeding-time expressions.

L. R. Brightwell

LION STUDIES.

so-called "King of Beasts" will compare with any other wild beast in daring and courage.

Lions were amongst the first wild animals to be kept in London, and were represented in the quite early part of the nineteenth century in the collection of wild animals exhibited at the Tower. On the foundation of the Zoological Society in London these lions were transferred to Regent's Park, there to form a nucleus of the world's greatest menagerie. Some twenty or thirty lions are usually inmates of the gardens which of late years has been most successful in rearing cubs. Formerly the Zoo was unfortunate in its endeavours to bring up lions and other members of the cat tribe, the cubs so frequently being devoured soon after birth by their mother. The reason for the failure probably was that the parent was disturbed by the noise and antics of the large number of visitors, who, hearing of the "interesting event," attempted to catch a glimpse of her offspring. The new policy of the Zoological Society of keeping secret from the public the news of the birth of their lion cubs until the youngsters are able to look after themselves, and of their own accord leave their specially constructed sound-proof chambers, has resulted in a number of additions to the lion house. The lioness is usually an exemplary mother—solicitous, playful and yet stern as occasion demands. She is no believer in sparing the rod, and can if necessary enforce discipline with a firm but gentle tap that to the human ear suggests the knock-out at a prize fight. Like the domestic cat she often carries her young about with her in

her mouth, taking them up by the scruff of the neck. Baby lions grow apace, for the year-old cub is as big as a Newfoundland dog and ten times as strong. At this age it still retains its "birth marks" of spots from which we may infer that the first lion was a creature spotted like a leopard. Many of the Zoo cubs have attained to some notoriety in the public eye, for they have been allowed to roam in open air enclosures playing alternately with a wooden ball or any keeper who could spare the time for a romp. In the early days of the Zoo some of the big cats suffered much petty annoyance from the vermin which patrolled the cages after closing time. As a result domestic cats were introduced to aid in the extermination of the rodents. The forest giants at first showed some resentment at the intrusion of their inferiors, but quickly learnt to associate them with a welcome reduction of the midnight pests. Even to-day a cat—a mere mascot—stalks up and down the lion house disdaining and disdained by the kings and queens in exile. As a matter of fact many houses in the gardens have their semi-official cat, a self-appointed assistant to the anti-rat campaign. Sometimes these cats rise by sheer force of character to an honoured position. "Mr. Toots," a big black tom of semi-clerical appearance, was a famous instance. He ornamented the camel house, and always slept upon the larger hump of a huge Bactrian camel. The camel and his stable mate were quite willing, when feeling a little off colour, to bite their keeper, tread on his feet, or try to wedge him against

the wall of the enclosure, yet they never attempted to harm "Mr. Toots." He received an official ration from the authorities, and died one of the most honoured and lamented of the Zoo's "irregulars."

Some years ago a terrier was introduced into the cage of "Old Girl," a sick lioness in the Dublin Zoo, with the object of defending her from the rats which had begun to nibble her toes. At first the dog was not at all welcome, but when the lioness saw him kill the rats she began to appreciate her visitor. Eventually she coaxed the terrier to her and folded her paws around him. The dog slept each night on her breast enfolded by her paws, thus protecting the aged lioness from disturbance. A lion and a dog for some time shared a cage in the Melbourne Zoo. The association arose as a result of a lioness giving birth to a number of cubs one of which was taken away and given to a mongrel terrier foster-mother. The dog was devoted to her charge, and grew prouder and prouder as her nursling developed. The two animals became so fond of one another, fretting if separated, that they were left together for three years. The dog however came to dominate over the lion, which had developed into a particularly large and handsome specimen, and at feeding time would not allow her foster-child to take his share of the meal until her own appetite had been satisfied. The end to the companionship came, not, as one might suppose, by the dog being devoured, but owing to the insistent protests of the public against the cruelty to the lion, which led to the

animals being separated. The dog was at first heart-broken, but on being given a second lion cub to rear in time entirely forgot her first charge.

The lion house at the Zoo is so contrived that one can feed or bed down an animal, or even conduct a minor operation upon it, without having to enter its cage. At the same time a number of the pensioners will permit themselves to be brushed down and combed without entertaining any resentment against their valet.

The "terrific" roar of a lion which is frequently described as unique, has been very much exaggerated. Livingstone and more recent explorers have recorded the difficulty they often experienced in distinguishing the roar of the lion from that of the cock ostrich, whilst early morning visitors to the Zoo reptile house may ascertain for themselves at first hand that a large alligator can make the rafters ring as vibrantly as any lion. It must be remembered that the roar of the Zoo lions is enormously enhanced by the acoustics of the lofty house.

Lions and tigers must occasionally come together in the wild, and it is reasonable to suppose that marriages between the two animals occasionally take place. The outcome of such a union has not yet been shot either by the rifle or the "movie-man," but lion-tiger and tiger-lion hybrids are now and again bred in menageries. At the time of writing a full-grown specimen of the latter hybrid is an exhibit in Regent's Park. The animal bred in India on the estate of H.H. the Maharaja Jam Sahib of Nawanager, better known as Prince

Ranjitsinhji, is a huge creature standing higher than either a lion or a tiger, and has a very large head with a rudiment of a lion's mane. The head and legs are faintly striped. A similar cross was exhibited in Hagenbeck's menagerie in Hamburg not so very long ago. The offspring then, as in the present case, was of large size, and weighed as much as the two parents together.

The parents of the Zoo hybrid died as a result of a fight after living together in harmony for several years. The dispute which was started by the lion and arose over a piece of meat, resulted in both combatants receiving mortal wounds.

The tiger from early times has lent itself to pageantry, and even to-day a "tiger-drive" is often attended with as much picturesque ceremony as ever it was in the days of ancient India before the advent of Western civilization. The tiger like the lion was exploited in Roman times on the grand scale. How the local dealers managed to supply the demand for the Roman arenas is difficult to conceive. Scylla accounted for nearly a hundred in a few months. Cæsar modestly contented himself with about two hundred. Heliogabalus rode in a chariot drawn by four tigers and as many leopards, whilst Nero habitually kept a huge tigress hanging about his private apartments as sort of super-bodyguard. The tiger equals the lion in size and usually exceeds it in ferocity. It is estimated that at least a thousand human beings are annually slain by tigers in India, China, and Siberia, and there is reason to believe that the number may be far exceeded. Some tigers

nevertheless become very tame in captivity and two exceptionally large animals in the Regent's Park menagerie are exceedingly affectionate and when patted roll about on the ground in an apparent paroxysm of joy.

The tiger differs markedly from the lion in its choice of habitat. Whereas the lion haunts the plains, the tigers frequent dense bush. Both animals are perfectly "in tune" with their surroundings. The lion's khaki-coloured skin melts into the background with baffling efficiency. The tiger's bold stripe-pattern similarly becomes one in a setting of tall bright stems, and dark longitudinal shadows. The tiger cubs are miniature replicas of their parents in marked contrast to lion cubs.

The range of the tiger is interesting, since, although absent in temperate regions, it flourishes in extremes of heat and cold. Common in the hottest parts of India, Burma, and Sumatra, it is also found at the height of six or seven thousand feet up in the Himalayas, and occurs in Siberia where it develops a thick and almost shaggy coat. The male tiger develops stubby "mutton chop" whiskers—the best he can do in the way of a mane, and consequently looks smaller than a full-grown lion. Actually he is a slightly bigger beast but lacks the lion's voice. Tigers at times emit a short rasping roar; but more usually a roof-top "mew" on a big scale.

The leopard enjoys a much wider range than either the lion or the tiger, and is still sufficiently numerous to exert a check upon the surplus population of tropical Africa and Asia. In the

old Roman days the animal was used in enormous quantities for the purpose of destroying objectionable Christians, gladiators, bulls, bears, etc. This gorgeously-tinted cat exhibits great diversity of colour. Certain specimens show fawn markings on a creamy ground colour, whilst others may be entirely black. The latter, which are particularly common in the Malay Peninsula, are generally regarded as being much fiercer than the normally coloured animal, and have been stated to be quite untameable, even in the cub stage. That however is not true, as a number of black leopards which have been exhibited from time to time in our Zoological Gardens have failed to live up to their reputations and have proved in several instances on the contrary unusually tractable. Like the lion and tiger, the leopard, especially when old, may become almost exclusively a man-eater.

The jaguar of South America resembles the leopard in size and form. It, and the uniformly dun-coloured puma, the most docile member of the wild-cat family, are the only two large cats inhabiting the New World.

A few of the big cats can be trained to man's service. The Cheetah of India, the Serval of Africa, and the Caracal of Persia have been all used for coursing. Of these the cheetah, which looks like a high standing, spindle-shanked leopard, is pre-eminently the swiftest, and is in constant demand by the sporting potentates of Central India. Cheetahs are taken to the meet hooded, covered with gorgeous trapping, and are carried

on horseback or upon specially constructed bullock waggons. They run down the quarry at an incredible speed, covering the ground in a series of enormous bounds.

The most handsome of all the leopards is the Ounce or Snow Leopard of Thibet. To meet the extreme cold of the Himalayas it has an enormously thick bushy coat, the large black spots showing in a rather cloudy manner against an ashen ground. The animal is capable of conceiving great affection for its keeper and may on occasions insist upon his company with such well meaning but massive persistence as to render his withdrawal from its cage a matter of considerable tact. A number of natural history and travel books record the statement that the larger members of the cat tribe will always attack black men in preference to white :

“A lion never will attack
A white if he can get a black.”

It is certainly true that the feline inhabitants of our zoological gardens become restless whenever they see a negro or Indian, and some comparatively tame lions, tigers and leopards have on occasions showed signs of extraordinary excitement and ferocity at the presence in their house of oriental visitors.

CHAPTER VI

THE SWIMMING BATH

THE Zoo's swimmers vary infinitely in shape and size, but they all, excluding some of the inhabitants of the aquarium, have two things in common, two things indispensable to anyone making swimming an almost life-long occupation—fat, and a “swimmer’s foot.” Fat is of course vital to keep out the cold during long immersion ; and constant treading of the water tends to splay the pedal extremities—sometimes to a grotesque degree. One of the menagerie’s champion swimmers is the hippopotamus, a creature which, owing to its massive form and its habit of swimming totally submerged, is seldom given its due as the Captain Webb of the wild animal world. The common hippopotamus of the tropical rivers of Africa may attain a weight of over four tons and is, next to the elephant, the bulkiest of all existing animals. It is characterized by very short limbs, four toes of equal size partly connected by webs, large incisor teeth which grow throughout life, a large and somewhat elongated head, a pair of very small eyes, and an enormous cavernous mouth with which it is capable of indulging in a four-foot yawn. The only other

living species of hippopotamus is the pigmy form of the almost inaccessible swamp regions of Liberia. The disparity in size between the two is very remarkable, for the pigmy hippo seldom reaches a height of thirty inches, and never weighs more than $3\frac{1}{2}$ cwt. A full-grown specimen is in fact equal in size to that of a year-old baby of the common hippopotamus. Apart from its small size, it differs in a rounder head, much longer legs and tail, and in the eyes not protruding in the manner characteristic of its only living relative.

Although well supplied with hippopotami the Zoo has no individual on its books to-day to compare with Guy Fawkes, who for many years held the proud position of the oldest inhabitant of the gardens. His father, the first hippopotamus to be exhibited in Regent's Park, arrived in the year 1850, and a wife was found for him four years later. Guy Fawkes who saw a number of other hippos arrive and leave the Zoo, was born in 1872, and lived until all London mourned him in 1908. Few animals gave more pleasure to the public or more anxiety to the authorities.

He had a very uncertain temper, and when sulky would put up a ten hour swim without deigning to come ashore in response to public blandishments. On one occasion he gained access to the wrong paddock, and was only induced to return to his own enclosure by being lured back at a heavy but furious gallop, in chase of a particular keeper for whom he had a strong aversion.

The Tapir, that curious beast which combines



Hippo - ashore.



The ever open door.



Baby carriage



A tail-piece.

L. R. Brightwell.

HIPPOS.

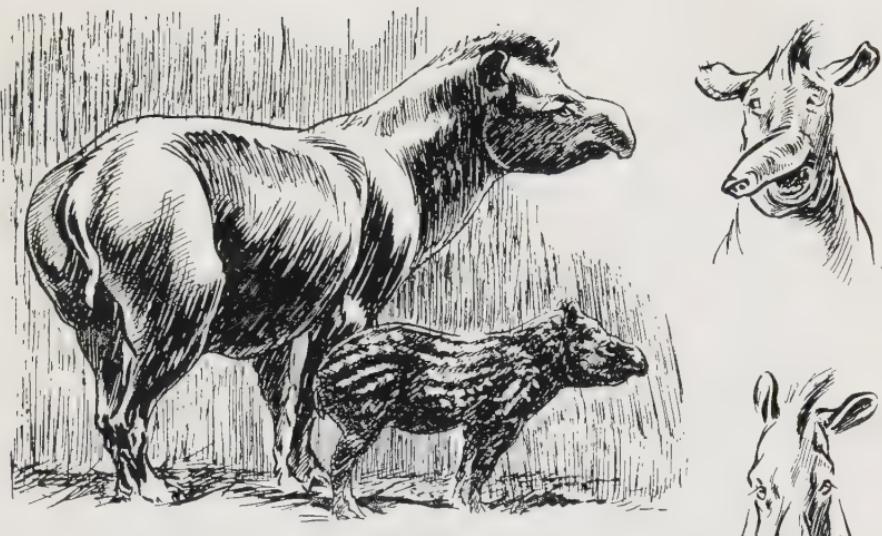
the external features of the horse with that of the elephant in almost equal proportions, is another born swimmer that however does not look like one. Ages ago when the mammoth roamed the earth it enjoyed an almost world-wide distribution and often attained to the dimensions of a hippopotamus. To-day only five species of tapir survive. One is limited the the Malay Peninsular ; the other four are confined to the swamps of Central and South America. In the American forms the skin is uniform black, but in the Malayan, the largest of the five, the middle part of the body is silver white. They are all still tolerably abundant, despite the fact that their flesh is highly esteemed and their hide in great demand. Tapirs inhabit dense reed thickets wherein they make long runs, and live upon swamps and aquatic plants. They are, as a rule, gentle and docile in captivity, and breed freely. The young of all tapirs are barred and spotted with white, as were probably their prehistoric ancestors.

Generally silent the tapir can under stress relieve its feelings in a shrill cry. It is a rather dull animal, but a certain Brazilian tapir at the Zoo evinced a sense of fun, as during the summer months it would resolutely refuse to go to bed, and by galloping furiously round and round its paddock regularly exercised three keepers armed with stable brooms for a good hour after the staff was entitled to " knock off." As a swimmer the tapir shows great agility, and like the hippo it is capable of performing a running dive. This ability to swim stands the American species in good stead when pursued by the

jaguar. But the water too has its terrors. The big aquatic snake, the anaconda, sometimes claims a tapir in mid-stream, whilst the "cariba" fish, which congregates in large shoals, offers a continual menace. Surrounding the swimming tapirs a number of cariba may with their razor-edged teeth literally tear the animal into small pieces before it can gain the further shore and safety.

Although we have given the Hippopotamus the pride of place by virtue of its size, the Sea Lion could easily carry off the mammalian "belt" for grace, agility and high diving.

At one time the Zoo sea-lions emulated their music-hall confrères and mounting upon chairs balanced footballs and bottles on their noses. To-day feeding time is made a much more natural and artistic exhibition, and there is no finer sight in all the gardens than that of these animals hurling themselves off a twenty-foot cliff, or surging through the water, twisting and turning whilst at full speed and dodging submerged rocks with a consummate grace and rapidity that reduces by comparison the best efforts of a motor launch to the feeble progress of a canal barge. The sea lion has a big brain, and vast capacities for cunning and resource. He can escape from almost any kind of enclosure or packing case unless the most vigorous precautions are taken. On the other hand he will protest loudly at being required to pass through a doorway to which he has taken a dislike. The animal usually objects to negotiating any aperture the sides of which he can touch with his flippers, unless there is some object



Brazilian Tapir and young.



Malayan Tapir.



TAPIRS.

in his doing so, when he will squeeze through a fissure that threatens to crack his ribs. The intelligence and endurance of the sea lion may be utilized for more practical purposes than mere entertainment "stunts." Not long ago a demonstration was given at the Westminster baths which proved that a sea lion could save life according to the Royal Humane Society's rules. At the Dresden Zoo the sea lions collect money to pay for their keep. A tall post with a pulley cord is so arranged that visitors may place a coin in a slot near the base of the post. The sea lion then becomes active. Seizing the end of the cord in his mouth he gives a vigorous jerk which forces a fish up a tube to the top of the post, where it shoots off a miniature diving board into the air and falls into the mouth of the expectant sea lion. It is no longer a secret that during the Great War the sea lion played his part in tracking submarines in the early stages of the conflict, before he was superseded by the more reliable hydrophone. The sea lions touring the halls were commandeered, and put through a rigorous course of training in a London swimming bath. The most efficient recruits were then taken to the coast where they were taught to report on any unusual vibrations under water by at once coming to the surface and barking vigorously. A long cord was attached to the sea lion, connecting him with a scarlet buoy, so that he could always be kept in sight. The sea lion corps developed but one deserter, and for all that is known of him he may still be at large in the Channel. Quick as the Zoo sea lions are to capture fish under water, or when thrown

to them in the air, they are not always quite quick enough. In winter the gulls haunt the sea lion pond at feeding time, and sometimes get there first. The gulls hold the trump card, for they can fly. This was not the case with the penguins when they shared the pond with the sea lions. All went well until one fateful day a penguin attached itself to one end of a whiting and a big sea-lion to the other. The sea-lion to save time swallowed both the fish and the bird. This was bad, but worse was to follow, as from that day onwards the sea-lion acquired a taste for penguins, and proceeded to attack the remaining birds with which he had previously lived in harmony. The sea-lion like most other creatures plays its part in the scheme of things, as the following story goes to show. Up to a few years ago the guano deposits on a group of lonely islands off the Californian coast were bringing in a fortune to a certain company. To-day there is not enough guano left there to fertilize a window-box. The tragedy is explained by the fact that man attempted to upset the "balance of Nature." The sea-birds that deposited the guano lived on fish, which they shared with a large colony of sea-lions—thousands upon thousands of them. The directors of the company conceived the notion that if the sea-lions were removed there would be more fish, and as a natural sequence there would be more guano. Rifles soon eliminated the sea-lions, but from that time onwards the birds that laid the golden manure died or departed. The company promoters had failed to realize that the far-ranging sea-lions had acted as so many sheep dogs and

rounded up the fish until they came within easy distance of the birds.

It may not be generally known that the sea-lion has an ear for music. This was proved conclusively at Regent's Park. A string orchestra once favoured the sea-lions with a wide range of selections. Chopin and Brahms caused the sea-lions to come half out of the water, and with their eyes half closed to remain in dreamy ecstasy, until the last strains had died away. Noisy martial music seemed to worry them. Jazz sent them below.

Sea-lions are occasionally born and bred in Regent's Park. Although born to a life afloat the infant sea-lion is not allowed to enter the water for the first few weeks. His head is then so enormously disproportionate to the rest of him that it would probably take the creature straight to the bottom if launched. At a later stage the education of the baby is taken in hand, and much entertainment is caused by observing the mother dragging her offspring by her flippers after her into the water. When about a couple of months old the little sea-lion still swims very clumsily, and can only maintain itself for a few seconds in the water. As soon, however, as it shows obvious signs of distress the mother by swimming under her baby succeeds in getting it on her back, and makes for the shore. The father takes no part in the swimming lesson, and appears to avoid his offspring.

To the inhabitants of certain parts of Hampstead, sea-lions are regarded as being weather-wise, as they have observed that a sea-lion concert is almost invariably followed by rain. Our meteorological

authorities would, however, receive little assistance from them, as their insistent barking denotes nothing more than a healthy appetite. The phenomenon is explained by the Zoo's topographical position in relation to the district where they are heard, and in conjunction with the fact that the sea-lions are only audible there when the wind shifts to the south-west.

The Common Seal which differs from the sea-lion in having no external ears, in its very, very short front flippers, and in dragging its hind limbs which are not made use of in progression behind the body, appears to little advantage above water-mark. Under water he is however as active as his larger relative and will travel at thirty miles an hour when pursuing fish. Many have come to the Zoo as the result of involving themselves in herring nets, whilst a few have paid the penalty of straying far up the Thames.

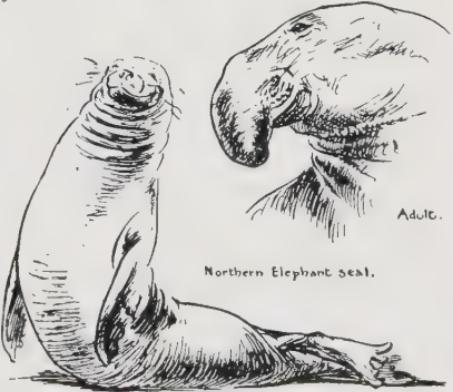
Of recent years the Regent's Park menagerie has been ornamented by young specimens of the Elephant Seal averaging a length of seven feet, and a weight of 600 lbs. The elephant seal lives in the South Atlantic, Pacific and Indian Oceans and lays claim to its title on the grounds that in the adult male, which reaches a length of twenty feet, the snout develops a sort of exaggerated Roman nose or trunk about a foot in length. At the Zoo he chiefly calls attention to himself by sitting up and giving long hissing sighs, suggestive of the gradual collapse of a balloon. The plasticity of the elephant seal is extraordinary, for when out of the water he can rear



In full swing.



Baby Walrus.



Northern Elephant Seal.

Young - "look out" pose.

H. R. Brightwell

SEA LIONS, WALRUS, AND ELEPHANT SEAL.

Facing p. 262.]

up until his front flippers are clear of the ground, and can then bend backwards to make his snout touch his short stumpy tail. It is questionable if any inmate of the Zoo's swimming bath ever enjoyed such universal popularity as did the late lamented "Andy," a young walrus from the far North. Andy who cost the Zoological Society about £10 a week in fish might have lived to cut his tusks but for suddenly breaking a blood-vessel whilst under water in the hot summer of 1925. He enjoyed a most tractable, not to say endearing, disposition, and would follow his keeper like a dog, loudly bleating for attention from all and sundry. The walrus, if bred to maturity in a zoo, might prove, however, something of a problem, for, quite apart from his food bill, his temper does not improve with age and would necessitate an "elephant proof" enclosure. The adult bull walrus like the adult bull elephant is apt to be troublesome and in Alaska an old bull walrus will often develop a penchant for killing seals. This makes him a marked beast and the Esquimos do not rest until the criminal has been killed. Cod soaked in whale oil seemed to suit walruses in captivity instead of their native clams which they grub up with their tusks, and sift away the mud attached through their soup-strainer moustaches. They are slow, bulky animals, built on too clumsy a plan to often catch the swiftly-moving fish. The walrus inhabits all arctic waters but is fast diminishing in numbers, especially off the coast of North America where it is much hunted for the oil it produces and for its valuable tusks. According to American official reports recently published, 2,000,000

gallons of walrus oil is the annual yield, representing the destruction of more than 100,000 animals.

For general activity, and capacity to enjoy life, the otter runs the sea-lion a very close second. This fascinating creature, which has a remarkably flexible body, haunts the less frequented waterways of Great Britain, making its home in excavations dug in river-banks or natural hollows beneath rocks or the roots of trees. In such retreats the female rears a litter of usually three or four cubs, which she trains to catch fish at an early age, and joins them in the most eccentric and extravagant under-water gambols. Although at times condescending to kill and eat water-rats, the otter is essentially a fisherman and, like some other exponents of the gentle art, often kills more than he requires. Game-laws and close seasons mean nothing to him, hence the price upon his head. Otters are particularly fond of the "shoulder piece" of a trout or salmon, and a single animal will partake of this delicacy from a score of fish in succession, leaving the rest of the fish to pollute the stream. As often as not the carcase is dragged upon the bank, and left an affront to the water-bailiff or gamekeeper. The otter has of late years done well at the Zoo, considering its necessarily restricted quarters, showing high intelligence and making an entertaining exhibit. It will amuse itself for hours together with such inappropriate offerings as oranges, carrots and buns, which have been thrown into its swimming pool by a well-meaning if ignorant public. Before the construction of their present pond in 1920, the sides of which are undercut,

the Zoo otters managed to escape at fairly frequent intervals. One of these creatures that succeeded in some mysterious manner in climbing the fence of its enclosure, made for the Regent's Canal, where it was mistaken for a sea-lion. The information was brought by the skipper of a barge, who in forcible language resented the suggestion that his knowledge of zoological nomenclature might possibly be at fault. He stated that the sea-lion could be seen disporting itself in that part of the canal that lies opposite the Albany Street barracks. An expedition was at once formed, and a number of keepers with nets and buckets of fish were soon on the scene, where they saw, but failed to capture, the escaped otter. That such a mistake in the identity of the animal should have been made did not greatly surprise the Zoo officials, as another otter that left the menagerie without being invited to do so, and which was eventually recaptured in the backyard of a house in Camden Town, was mistaken by its captor for a Kangaroo !

The beaver, an aquatic rodent now confined almost exclusively to Canada, but which up to a few years ago still haunted the Rhone Valley, is a Zoo favourite that has not only little to learn in the art of swimming, but is actually capable of constructing its own swimming bath. It makes deep burrows in the banks, and supplements these with enormous mounds of sticks and branches, which may sometimes attain the size of a small bungalow. To "work like a beaver" has become part of our national speech, and it must be admitted that no stories related of the

energy of this animal can be too extravagant to be wholly incredible. An eight-hour day is a very gentle spell of work for a beaver, for when preparing to make a lodge in order to protect itself against the rigours of the winter it will go on working until its strength gives out. The indefatigable builders ply their trade chiefly at night, raising large dams, constructing ponds, canals, and felling trees, sometimes over a foot in girth. After eating the bark and cutting off the coarser branches the trees are often allowed to float down stream in true lumberman style. These energetic animals have from time to time caused considerable inconvenience by raising dams of such a size and strength as to effectually block large streams and flood the surrounding country. The beaver's most striking feature is its enormous naked trowel-shaped tail. It has often been asserted that this appendage is used to smooth the walls it erects. But it is not so, all the plastering being accomplished with its fore-paws. The tail is used only as a rudder—and an alarm gun. Should the animal be suddenly scared it at once dives into the water and in the act brings its tail down upon the surface with a loud resounding smack. This is the "take cover" signal, and every beaver in the neighbourhood immediately acts upon it. Want of space has compelled the London Zoo to confine its beavers in a comparatively small enclosure, where they content themselves with a little tree-cutting and the construction of diminutive lodges.

The large Coypu Rat of South America, whose fur is sold under the trade name of "nutrea," and the Capybara, the largest of living rodents, which attains

a length of over four feet and a weight of 120 lbs., also an inhabitant of the South American continent, are other keen competitors for the Zoo's swimming championship. The former animal is frequently exhibited in travelling menageries as a giant rat from a London sewer. Both the coypu and the capybara are being fast hunted to extinction, and like so many animals will soon find zoological gardens their last line of defence.

Of all the members represented at the Zoo congress of bird swimmers the penguin is certainly the most popular with the general public. Although ashore he is a distinctly clumsy and ungainly creature, and a subject for mirth, afloat or under the surface of the water he cuts a very different figure, and is more than capable of holding his own against his aquatic competitors. Although when reduced to a skeleton the penguin is obviously related to the domestic fowl, in life there is little about his general appearance to proclaim him a bird. His beak and webbed feet he shares in common with several mammals, whilst his bodily covering is more suggestive of fur than feathers. A score or more different kinds of penguins are known, the various species ranging in size from that of a domestic duck to that of an eight-year-old child. All bear a strong family likeness and are very similar in their ways of life. They are essentially birds of the Southern Hemisphere, the Galapagos Islands being their most northerly station. In the blizzard-enshrouded islands in the far south penguins breed by the million and cover the ice-bound landscape with their quaint uniforms of black and white.

The penguin lays but a single egg which is tucked snugly away between the mother's feet. In due season the chick emerges—a weird caricature of its parents, being clothed from head to foot in a shaggy brown coat, suggestive of a human arctic outfit. Although able to walk about at a quite early age, it cannot feed itself and relies for sustenance upon the fish brought to it by its elders. Should a baby penguin become orphaned a host of adults are only too ready to foster it, and the chick is sometimes literally choked and smothered by a swarm of would-be parents. Penguins have no means of defence and although their slaughter is now a matter of legislation several millions are annually killed for the oil they produce. Such, however, is their fecundity that they are far from immediately joining the ranks of the extinct. As a number of popular films have revealed they are amazingly simple and unsophisticated creatures, readily making overtures to that most dangerous of all animals, man, upon the shortest of acquaintanceship. The average penguin can remain several minutes beneath the surface of the water and can under pressure swim with astonishing speed. When the necessity arises—as for instance when pursued by the killer whale, which abounds throughout the Antarctic seas, it can attain sufficient momentum to heave itself high and dry upon an ice-floe two feet at least above the water line.

That the penguin's sight is far better below than above water is appreciated by the visitor to the diving-birds' house where he may observe a single specimen let loose in its swimming tank run down

and pouch some thirty minnows in less than a couple of minutes. Apart from penguins the diving-birds' house is often tenanted by Guillemots, Cormorants, Razor-bills, Divers, Darters, and Puffins. The Great Northern Diver, which has a very striking black and white plumage, is remarkable for its almost demoniacal cry. It is capable of total submersion for over eight minutes, without coming to the surface for a breather.

The Darters of India, Africa and America closely resemble the common cormorant, but have the neck bones arranged on a sort of hair-trigger principle, so that the neck "goes off" with a jerk, and the needle-pointed bill transfixes the fish at a blow. Whereas the cormorant swallows its food under water, the darter always brings its catch to the surface before devouring it.

The waste fuel exuded by oil-driven vessels is the undoing of many of these birds, and they are sent to Regent's Park by humane holidaymakers after a more or less unsuccessful attempt has been made to cleanse the helpless sufferers.

Many expert swimmers are content merely to flirt with the accommodation provided for them at the Zoo. The Pelicans although found encamped around the larger temperate and sub-tropical lakes of both hemispheres, seem only to swim from necessity. They live entirely upon fish which they store in the enormous membranous pouch beneath the bill. They are most voracious creatures, and dinner-time at the Zoo is always made the occasion for a good deal of petty larceny. In the wild state they will nest either

in trees or on the ground. There are never more than three young at a time, and these are fed, as in the case of certain other birds, upon the partly digested fish regurgitated from the parent's stomach —a habit which gave rise to the legend that the pelican fed her young with blood from her own breast —a piece of un-natural history which has won the bird an undeserved reputation for self-sacrifice. One species of pelican often seen in our gardens develops a horny ornament on its bill during the breeding season, which decoration it sheds after matrimony.

The Flamingos of which the Zoo has quite a flock, normally inhabit much the same situations as those affected by the pelicans. In the wild they form vast colonies where the hens raise curious chimney-pot shaped nests of mud with hollowed tops. In the cup-like depression the egg is laid and being nearly a foot above ground is quite secure from any sudden rise of the adjacent waters. The flamingo's extraordinary bill is only a very exaggerated version of the duck's strainer beak, and is perfectly adapted for sorting out small snails, etc. from the river mud which it frequents. Although hailing from sub-tropical regions flamingos can endure great cold, and occasionally suffer for presuming on their hardiness. During frosty weather these birds at the Zoo are kept indoors, not that they require warmth, but because some years ago they delayed so long leaving their pool that the morning frost found them frozen fast by the ankles, in which undignified pose they suffered considerably, and were forced to remain until rescued. A worse case was that of a water-hen which sat down



Typical toilet attitudes.

Immaculate



A luncheon discussion.



"Airing" the pouch - by turning it inside out.



"Tea for three"

L. R. Brightwell.

A fledgeling.



PELICANS.

on the ice and being suddenly startled arose in a great hurry and left her tail feathers behind her.

In spite of their enormous bulk the Crocodiles and Alligators are to be reckoned with to give a good account of themselves in the Zoo's swimming championship. They are indeed fitted admirably for an aquatic life, for apart from possessing webbed feet and a compressed tail adapted for propulsion in the water, their eyes, nostrils and ears are situated right on the top of their heads with the result that these organs are able to function when the reptiles are floating about with only the upper part of their heads exposed. Further the nostrils and ears are furnished with movable valves which close when the animals are submerged, thus preventing the inflow of the water. The eyes in addition to a pair of eyelids, are protected by transparent discs, whilst the very broad tongue is so attached that it forms a valve to prevent the water rushing down the throat when the mouth is open.

The question as to what constitutes the difference between a crocodile and an alligator is one that is constantly being put to the writer and to the keeper of the Zoo's reptile house. The differences are chiefly of an anatomical nature. Broadly speaking in the crocodiles the snout is more or less pointed, and the fourth tooth of the lower jaw, the largest, fits into a notch in the upper, whilst in the alligators the snout is usually rounder, and the tooth in question fits into a pit. Crocodiles in captivity remain almost invariably savage, but alligators become comparatively tame, and the keepers in the reptile house enter the

tank of the large, ten-foot-long specimens without the slightest danger of being attacked.

The Porose Crocodile, a man-eater attaining a length of twenty feet and a weight of over a ton, is the most aquatic member of its tribe. It swims far out to sea and occurs in numbers in the Indo-Pacific region. Unlike other crocodiles and alligators it only leaves the water in order to lay its eggs, and the family cares having been cast aside it once more roams the oceans. The African crocodile is another man-eater. At a recent meeting of the Zoological Society Mr. Swynnerton, the game warden of Tanganyika Territory, exhibited the contents of the stomach of a large specimen which he had shot. The exhibition was of a decidedly gruesome nature, for apart from antelope hoofs, tortoise-shells, and porcupine quills, the reptile when opened was found to contain a large number of metal bangles such as are worn as bracelets and anklets by the native women, beads, and a long strand of metal cord. The strand of cord solved the mystery of the disappearance of a native boy, who was known to frequent the neighbourhood of the river-bank in order to collect wood, the cord being similar to the type he used for tying his bundles together. Two small pieces of elephant tusk were also found in this crocodile, but no explanation was offered as to how they came into the reptile's possession. If the full facts were known they would no doubt bring to light another human tragedy.

The Zoo crocodiles and alligators are as a rule voiceless, but on occasions, for no apparent reason,

they break forth into a reptilian oratorio which if not exactly musical is at any rate awe-inspiring, and early morning visitors to the reptile house are now and then treated to a selection from their repertoire. The largest alligator starts the ball rolling. He opens with a few preliminary roars. The other alligators and crocodiles soon join in with the result that the house shakes with the din. Their voices differ according to the species to which they belong. Thus the American alligator roars like a lion, whilst the Chinese alligator produces sounds similar to those of an angry dog—only much louder. The long-nosed Indian gharial faithfully mimics a bad sailor on a rough sea.

CHAPTER VII

THE GIRAFFE

IT is difficult to ignore an animal that towers six foot or more above the tallest elephant, so that no apology is offered for giving the Giraffe a chapter practically to itself. The giraffe, which has been divided into a number of distinct species, a scientific achievement which meets with the approval of a certain type of zoologist, and its relative the Okapi, are both confined to tropical Africa, and are the sole survivors of a race of giants. The remains of extinct giraffe-like animals, some of them bearing enormous horns, have been found in Asia and Europe. But for vigorous protection the giraffe and okapi would by now have joined the great majority. Fortunately a system of "form filling" has been devised by the South African and other governments which usually breaks the "sportsman's" heart long before he arrives at the gun-loading stage. The animal is capable of giving very powerful kicks with its fore-feet. It relies for safety, however, mostly upon camouflage, the creature's wonderful spot-pattern blending perfectly with the checkering of sunlight upon dense foliage, and in the native bush it is practically invisible, even at a few yards'



"Maud" — at the age of 48 hours.

GIRAFFES

distance. The giraffe's five horns—four of which are hair clad, are of slight offensive power, although a big dent in the oak boarding of the giraffe house shows that on occasions they can be used with effect. This dent, now covered with a sheet of glass was caused by a giraffe which used its head and seven feet of neck to aim a death-blow at its keeper. The cause of discussion is not recorded. Even under great provocation the giraffe is practically mute, although capable when young of a feeble bleat.

The London Zoo was the first public menagerie ever to exhibit a living giraffe in England. Many have come and passed out since the first arrived, and their histories make interesting reading. Giraffes were known to the ancient Egyptians, and there was one at Rome at the period of Julius Cæsar's dictatorship. Later they took part in the triumphal processions of the Roman emperors. During the Middle Ages a few living examples were brought to Europe, but not until 1827 did one reach this country alive. In that year the Viceroy of Egypt obtained two young giraffes raised upon camel's milk, and he presented one to the French Consul, and the other to George IV of England. The animals travelled in specially constructed padded crates. The Paris specimen lived nearly twenty years, but its companion transported to London was less fortunate, and succumbed after only two and a half years' captivity. It is doubtful if even the arrival in this country of the most famous of American kinema stars could repeat the sensation which the first giraffe to arrive

in London caused throughout the land. For a time it appears, every fashion was à la giraffe, ladies wearing dresses, and men carrying handkerchiefs, bearing portraits of the animal. In 1836 four specimens arrived at the Zoo, from which quartet and their descendants seventeen giraffes were bred, the last survivor of the stock dying fifty years later. A disastrous fire broke out in the giraffe house in 1892 and the Zoological Society's entire stock of giraffes perished. For three years the Zoo was giraffeless, the Soudan from whence most living specimens emanate being closed by an outbreak of Mahdism. The giraffe trade recommenced in 1895, and a young female specimen was purchased from a dealer. A pair presented by the Governor of Kordofan in 1902 bred several calves, and of these, Maud, born five years later, still graces the gardens. She is remarkably docile, and was helped through her early days by means of an ordinary baby's feeding bottle.

Giraffes are amongst the most popular inhabitants of the Regent's Park menagerie, but full-grown specimens are valued at the Zoological Society's annual stocktaking at a very low figure. This is due to the fact that they cannot be transported owing to the enormous length of their necks which are too tall to pass under tunnels.

The Okapi whose very existence was unknown until about twenty years ago, was discovered by Sir Harry Johnston, who made paintings of it from life and sent home skins and skeletons to Europe. Since then a few unsuccessful attempts have been

made to keep young specimens in the Antwerp Zoo. It is a native of the Ituri forest where its possible existence was first suspected from the strips of strangely marked hide displayed on warriors' shields.

CHAPTER VIII

POUCHED ANIMALS

PERHAPS the most attractive visions of motherhood presented in the Regent's Park menagerie are to be found in those houses and enclosures allotted to the marsupials or pouched animals—a group now confined almost entirely to Australia. They exhibit an infinite variety of form, for some are like bears, some like wolves, some like mice, and a few like nothing on earth except themselves. All, however, are linked together by a single tie—the abdominal pouch, in which they spend their infancy.

The pouched animals when first they are brought into the world are in a very immature state and so entirely helpless that they have to be transferred at once to the pocket in which they suckle. Often they cling to their mother's apron strings until they are over a year old, and at the Zoo one may often see the youngsters having recourse to the maternal pouch when, owing to their having all but outgrown that receptacle, it must be found an uncomfortably tight fit.

The most familiar pouched animal is the Kangaroo. The first settlers in Australia having got over their astonishment at seeing such a peculiar animal



KANGAROOS

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desired to know more about the strange beast and conveyed their desire to the aborigines. "Kangaroo?" answered the natives. The name has remained, but without the question mark, for translated literally the word Kangaroo merely implies "What do you mean."

We are all familiar with the manner in which a kangaroo supports itself on its hind limbs and progresses by a series of long leaps. Although a champion long jumper, he does not, however, excel at the high jump, and captive specimens can be retained in their enclosures by a comparatively low fence. He is a born pugilist and may be seen any day in Regent's Park fighting out a twenty-minutes' round with one of his cage companions, boxing with great efficiency although with little regard for the canons laid down by the National Sporting Club. The animal's foot work is most noticeable and he can keep his opponent from closing with him in a manner similar to that formerly permitted under certain Continental rules. His kick is certainly far worse than his bite, and there are records of dogs and even men being ripped open by a single slash from a kangaroo's hind foot, which is armed with long claws. Indeed all the animal's strength appears to be concentrated in his hind limbs and tail, the latter appendage being used when resting in the manner of a shooting-seat. His fore-limbs are comparatively weak and of little use save at meal times. His brain like that of all the pouched animals is distinctly inferior in quality. The many species of kangaroos vary enormously in size, some being no larger than a

Pekinese dog, whilst others may stand nearly six feet in height.

The task of unpacking a large collection of animals is generally a rather dull piece of menagerie routine. On one occasion such a proceeding at the Zoo was enlivened, however, by the escape of a kangaroo which had arrived along with a large number of other animals from Australia. It went off at full speed and passing out of a service door which had been left open got clear of the gardens. As soon as those in charge had got over their surprise chase was given in a motor car, and the animal was eventually run to ground in the back garden of a house in Baker Street.

The Tree-Kangaroos differ from the ordinary forms of kangaroo in that the fore and hind limbs are much less disproportionate than is usual in the group. They have frequently been exhibited in the Zoo, where they climb the trees of their enclosure and browse on the foliage.

In pre-war days kangaroos were farmed extensively on the Island of Herm—one of the Channel group. Bean-feast parties visiting the famous shell beach for the first time often received something of a shock on suddenly being confronted by kangaroos, and the animals are reputed to have made more than one convert to the cause of total abstinence.

The pouched animals were amongst the first of the warm-blooded, hair-bearing vertebrates to appear on earth and can count some giants amongst their ancestors. Some of these must have been terrible creatures—monsters that preyed upon other vege-

table feeding forms. Only two carnivorous forms exist to-day—the dog-like Tasmanian Wolf, who is now on the verge of extinction, although not so many years ago he was still a source of great financial loss to the sheep farmers ; and the Tasmanian Devil, a thick-set stocky creature, deep black in colour, strikingly marked with white, somewhat suggesting a long-tailed bear cub. The kangaroo in wolf's clothing is a mountain beast, whilst the "devil" infests the bush. Both bring forth litters of three or four at a birth, thereby differing from the cautious kangaroo with its single or rarely twin offspring.

A pouched animal that makes a more or less satisfactory household pet is the Wombat, a creature which in shape and size somewhat resembles a month-old bear cub, but with a sluggish deportment that bespeaks a feeble brain. At the time of writing, one of these stodgy little animals shares a cage in the small mammal house with a volatile monkey who habitually uses his affable if heavy-headed stable companion as a pleasure horse.

The pigmy "flying" Phalanger, a small creature which has a habit of parachuting when jumping from branch to branch, thus preventing too rapid a descent, is another Australian marsupial which is occasionally on exhibition in Regent's Park. The head and body of the little animal measures barely two and a half inches in length, whilst the prehensile tail, the hair upon which is arranged in two fringes like the vanes of a feather, is not much longer. The "flying" apparatus consists of a lateral fold of skin which extends from the elbows to the knees on each

side of the body. The creature is able to direct its flight with marvellous accuracy for distances of over twenty feet, alighting gently on all fours and closing the parachutes as it settles on the trunk of a tree. Another peculiarity of the "flying" Phalanger lies in the fact that its strongly-clawed toes terminate in adhesive pads, with the result that when once the creature has fastened itself into an object it is only with the very greatest difficulty that it can be removed. The young are transferred into the abdominal pouch as soon as they are born and there they remain until they are able to look after themselves and indulge in parachute descents without the fear of "crashing."

A marsupial that shares the kangaroo's world-wide fame is the Opossum of America—the only pouched animal inhabiting the New World. Brer 'Possum has a prehensile tail and can climb like a monkey. The young—sometimes as many as seventeen at a birth—are placed by the mother in her "pram pocket" where they are nursed, each little "possum" clinging fast to its particular feeding bottle. When old enough they leave the pouch to mount upon their mother's back, the babies' caudal extremities taking a firm grip round the tail of the parent. Thus established the family may travel up and down the tallest of trees, over walls, or on to the roofs of houses. The opossum, as is well known, is an adept at feigning death, and thanks to this trait has sometimes been shifted at the Zoo from one cage to another with the naked hand. This procedure is, however, not to be recommended as on one occasion

the 'possum when least expected "came to" and gave expression to his disapproval of the move by almost biting a finger off the hand of the keeper that held him.

CHAPTER IX

PLEASURE TRAFFIC

MOST adults prefer a Sunday at the Zoo to any other day of the week, a preference, however not usually shared by the youngsters, who if given the choice would elect to visit the gardens on a week-day when the broadwalk is devoted, not to a Sabbath calm, but to a cheerful bustle of " pleasure traffic."

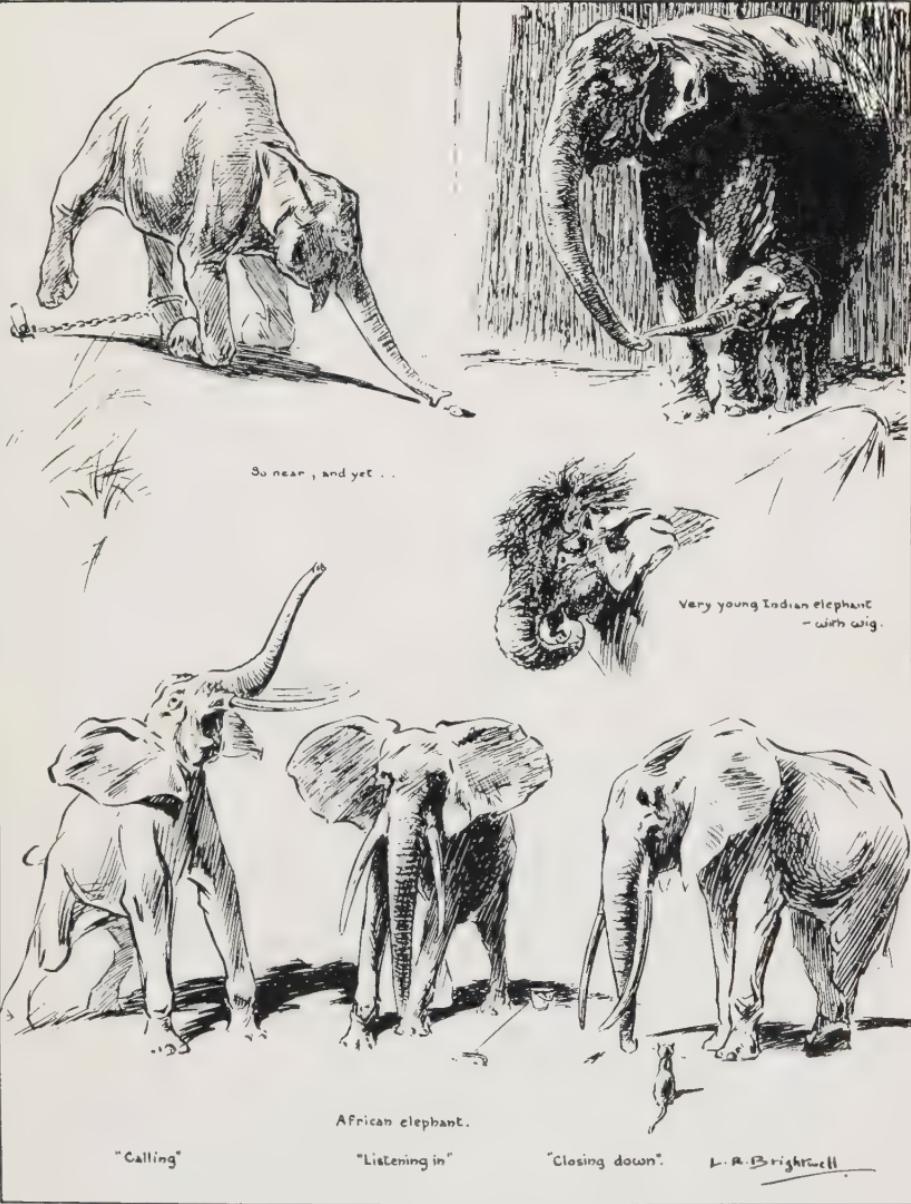
Almost every kind of animal capable of bearing a human's weight, or hauling a vehicle has at some time or other been pressed into service of mankind, but at the Zoo only such wild animals are employed whose docility in harness has stood the test of time. For six days a week throughout the greater part of the year the elephants, now mustering some half-dozen, amble sedately from the Old Tunnel to the Lion House and back again beneath their loads of delighted passengers. Exactly when the elephant first bowed his neck to service is a moot point. He was certainly in use as a beast of burden in the Orient many centuries before his dramatic entry into Europe in the van of Hannibal's invading hosts. Indian elephants were formerly the favourites with the Zoo officials, as they were considered more docile. It is now being realized that the African species,

whose education has in the past been much neglected, responds almost equally well to proper training methods, and several young specimens, some not bigger than ponies, may on any fine morning be seen at their lessons—dragging a number of long-suffering keepers round the gardens. Jumbo, the famous elephant, came from Africa, and was until his later years quite well-behaved. On occasions elephants that have for years been considered models of good conduct suddenly, for no apparent reason, refuse to obey the orders of their keepers. Thus on a certain recent Good Friday, “Indirani,” a fine Indian example which had carried passengers for more than a year, went on strike, refusing to remain still whilst being mounted. As the animal was only stubborn and not vicious, the authorities decided to see whether she would obey a native, and the services of a mahout were obtained through the Asiatic Home. The result of the experiment was extraordinarily successful, for the mahout, without punishing the animal, but merely lecturing her in his native language, obtained within a few days a complete mastery. The mahout, after kneeling down in front of the elephant and saying a short prayer, addressed the animal as follows : “ I am told you eat your food and will not work for it ; it is wrong. Allah enjoins us all that we must work if we want to eat. You are cheating your masters, which is unworthy of you. Put fear out of your mind and fulfil your allotted task.” The native was retained for the season, at the end of which time the English keepers had regained perfect control over Indirani, whose conduct has ever

since been exemplary. Immediately any of the riding elephants show signs of viciousness they are relegated to a life of idleness in the elephant house. A pair of veterans whose tempers are not as good as they should be are still popular exhibits owing to the manner in which they entertain their visitors by restoring to them the biscuits which strike the bars of their cages and fall out of reach of both themselves and the throwers. The animals point their trunks at the food and proceed to blow it with great power back to the feet of the donors.

Although capable of great speed on occasions the average broadwalk pace for an elephant seldom exceeds two miles an hour, as it is agony for him to pass a paper bag without examining the contents. Some years ago one of the large riding elephants was ambling along collecting all things edible on his route, when he spied what he thought was a well-filled paper bag lying on the top of a pram. Out shot the trunk of the animal, and, to the horror of the spectators, a sleeping infant was raised into the air to within a foot of his open mouth. The elephant realizing its mistake gently replaced the baby into its pram and continued its leisurely stroll.

During the summer of 1926 a so-called white elephant was exhibited in the gardens. It arrived from Burma accompanied by a normal coloured wife and five native attendants. Only the hairs on the animal were pure white, the skin being flesh-coloured. In Burma and Siam "white" elephants are held in great veneration as emblems of royalty and are still worshipped by the lower classes. Until



ELEPHANTS.

Facing p. 286.]

quite recently the ceremonies attending the capture of such an animal were most impressive. The discoverer of the sacred creature, were he the humblest man in the land, was immediately raised to high rank, paid a large sum of money, and exempted from taxation for the rest of his life. The ropes normally used for securing ordinary elephants were replaced by stout cords of scarlet silk, and the wants of the animal were attended to by princes and mandarins. Feather fans with gold handles were employed to keep the insects from it by day, and elaborately embroidered silk mosquito nets were provided at night. It was fed only out of gold and silver dishes. In the sixteenth century the natives of Pegu and Siam waged a war for many years over the possession of a white elephant, in the course of which thousands of men and five kings were killed.

Only once previous to the exhibition of the Zoo specimen was an albino elephant brought to England. This was in 1883 when one was exhibited by Barnum, the famous showman, whose agents before receiving the animal were compelled to sign a contract embodying the following clause : " We have sworn before God that we will take the elephant to love, honour, and protect it from misery. If not we know the sin cannot escape hell."

The Zoo's white elephant arrived from Burma at Tilbury Docks, where, owing to the state of the tide it could not be walked off the ship. The sacred pink animal had therefore to suffer the indignity of being slung ashore from a crane. Its march from the docks to Regent's Park, accompanied by its wife,

the Zoological Society's superintendent, and a retinue of native servants, caused a mild sensation amongst those suddenly confronted with this extraordinary procession. "Pinkie" as the elephant was nicknamed by a flippant public was taken for walks in the Zoo gardens, but in accordance with its semi-sacred character, visitors were not allowed to ride on it.

Amongst the riding animals, next in popularity after the elephants come the camels—the Bactrian with two humps, and the Arabian or Dromedary with only one hump. As experienced from the saddle or neck their motion is short and choppy, in contrast with that of an elephant which may be described as a slow easy roll like that of a ship in a swell. Two children on the neck, and two between the humps is the average load for the Zoo camels. Their full carrying capacity is approximately 1,500 lbs., but at Regent's Park they have never been confronted with the last straw.

A poor relation of the camel's, conspicuous on the broad walk pulling a pony chaise, is the Llama, who may be described as a sort of camel-sheep. It has been in general use as a beast of burden for many centuries. What the camel is to Arabia the llama is to Peru, where it is employed in thousands to carry merchandise across the Andes. Llamas when less carefully controlled and treated than those at the Zoo leave something to be desired as mounts. They have all the camel's obstinacy, and devilment, and will often signify their unwillingness to advance by turning their heads, confronting the rider with a

sullen stare, and then spitting in his face. The llama's power of expectoration is great, the saliva being ejected an extraordinary distance and with great velocity. A certain Zoo llama invariably spat on the appearance of a visitor wearing a "top" hat. Bowlers, boaters, homburgs, and caps were all regarded by this animal as unobjectionable, but at the sight of a "topper" it "saw red," and a fusillade was promptly opened on the visitor adorned with the offending headgear.

One or two other wild beasts of burden have from time to time graced the broad walk. A reindeer team has recently been installed, and when the snow is on the ground the keeper in charge needs only to dress for the part to recall vividly the romantic equipage of Santa Claus. Zebras have featured once or twice, and several lights of the coaching world in bygone days have astonished the Row by appearing behind one of these "jazz" patterned four-in-hands. A zebra between the shafts makes an extremely smart turn-out, the only drawback being that as a draught animal it has a tendency to bite through its harness, kick the gig to matchwood, and possibly carry the whole outfit through a plate-glass window. The trotting ostrich is less in evidence at Regent's Park than in certain foreign zoos—notably those in South Africa. The ostrich keeps up a very hot pace for a few miles, and is aided in its giant strides by its wings. A story has been told of an ostrich ride in a certain zoo in Holland, which deserves repetition. It appears that one of the service gates had been left open incidentally, and through this dashed the bird with

the visitor on its back at a terrific pace. It was a typically straight road, stretching away into the infinite without a turn to break its awesome monotony. The fare, unable to summon up the nerve to jump, had recourse to shouting for help, which merely encouraged the ostrich to redouble its efforts. The climax was reached when the bird, with its passenger still clinging on, collapsed on the road eight miles from home.

Whilst on the subject of ostriches, it may be mentioned that their formidable digestive powers are only too well known to the public, who at the Zoo have on occasions fed these voracious and inquisitive birds with substances which even the digestion of an ostrich was unable to cope with. Thus some years ago a fine specimen which died a few days after a bank holiday was found to contain 9½d. in coppers. The money was duly credited to the Zoological Society but was a poor recompense for the loss.

The wild African buffalo is justly regarded as being one of the fiercest of all animals, and is consequently treated with the greatest respect, not only by the natives, but by experienced big-game hunters. However, one large specimen, presented to the Zoo by Sir Edward Northey, was kept in a stable at Government House, Nairobi. It not only carried children, but for a time was actually employed in drawing a plough. On its release from its travelling case on its arrival at Regent's Park, the animal allowed itself to be placidly led through the gardens on a rope to its new quarters in the cattle sheds.

CHAPTER X

AFTER DARK

AT the Zoo the habits and customs of a number of animals that would only be astir in their native haunts after dark may be studied during the daylight hours. The reason is easily explained. Being fed by day, and having consequently nothing better to do at night, they just go to sleep. There are, however, a number of inhabitants of the menagerie that only become active at dusk, and nightfall is to them a signal to wake up and walk abroad. By day these animals may be observed asleep, or may only be represented by illustrated labels, apparently empty cages, or heaps of straw, although a very dull or foggy day may occasionally lure some of them into the open, deluded into thinking that night has come before its proper time. Suitable food is placed within reach just before the last of the day-staff withdraws—and in the morning it is gone. The majority are nocturnal because they find night the best time for hunting, and take advantage of the dim light to steal upon unsuspecting animals wrapt in slumber. Some have eyes with vertical pupils which can suddenly expand and take in every ray of light available, thus giving them command over many a situation which would baffle the purely diurnal.

Amongst the least civilized members of the monkey tribe, there are a number of curious forms that during the daytime are very retiring in disposition, and strongly resent being hauled out into the light for inspection. Their movements are as strange as their persons, and they are responsible for a great amount of native superstition. Such an animal is the Slow Loris, the " bashful-cat " of the Malays—a creature no larger than a guinea-pig, with a pair of huge, lamp-like eyes, and dainty padded feet. In captivity he is a sleepy little beast, much given to night-walking, and whilst moving with slow deliberation making mesmeric passes with his long lanky limbs. In the Malay States he is a power in the land, and every portion of him, especially the eyes, is valued as a charm or a love potion. His every activity—or want of activity—is believed to have some influence for either good or evil. In Regent's Park he is just *Nycticebus tardigradus*, and regarded as a specially " bad sitter " by the press photographer. The Malays magnanimously excuse his shy and " nervy " manner on the ground that he is always seeing ghosts. His expression certainly appears a startled one for his eyes look as if they were about to burst out of his head, an outcome of tense and constant peering in the dark for birds' eggs, tree lizards and the other choice items which go to form his menu.

The Tarsier, also an inhabitant of the Malay States, has all the " pop-eyed " appearance of the Loris, but is a much more active animal, hopping from tree to tree like a tree-frog, which it resembles in having toes which are flattened to form discs. In

the Aye-Aye monkey of Madagascar we have yet another case of specialization carried to extreme. Very few casual visitors to the Zoo have ever seen the animal alive, although it has been a more or less constant exhibit since the gardens' inception. The aye-aye shuns the light of day and only when the last visitor has left the monkey house does he emerge from his sleeping box, and with a pair of hands that look like two huge five-legged spiders, explores the virginia cork cage fittings in search of insects. Actually he finds himself reduced to eat minced meat, eggs and bread and milk, but the spidery hands are ever ready for the chance cockroach. A few privileged visitors to the Zoo have observed the weird shadowy form of the aye-aye by the light of a pocket lamp, creeping about his cage with slow deliberation, and have heard him utter at intervals the sad far-away cry from which he takes his name. No creature could be more perfectly fitted for its way of living than this aberrant member of the monkey tribe. Its huge lamp-like eyes put those of a cat to shame. The head is more like that of a young bear than a monkey; the tail which supplies the perfect balancing pole is bushy and fox-like, and the front teeth are large and chisel-shaped like those of a rat. The feet are, however, undoubtedly simian, for the great toe has a flat nail and is extremely long and slender, and is used by the creature in extracting insects from the cracks in the barks of trees. On dislodging the insects the spidery hands come into action, and with infinite delicacy catch them as they make for the "emergency exit." This long finger is likewise made

use of when the animal takes liquid nourishment, for when in the act of drinking he puts his lips to the water, and inserts this finger into his mouth behind the incisor teeth, drawing it rapidly backwards and forwards as the water is sucked up, in the manner of a man cleaning his teeth.

It is small wonder that such an animal has spread an aura of legend and superstition sufficient to make it dreaded by the less enlightened inhabitants of Madagascar. Many weird and horrid rites were once practised in order to counteract the supposed "spell" cast by the aye-aye, which shares much of the Malayan loris's power for "creating an atmosphere."

Amongst the Zoo carnivores the wolves and hyaenas are animals that without actually turning day into night are more active after than before closing time. The wolf is always impressive, but especially so on a moonlight night, when he possesses a dignity which no quantity of brickwork or iron bars can diminish. A full moon sets all the wolf-dens a-howl, and the animals may be heard on a calm midsummer night as far away as Oxford Circus. Just why they are affected in this sentimental manner, is still a matter for conjecture. The wolves in Regent's Park have a well-earned reputation of being able to forecast a change in the weather from fine to wet, their method of signifying a coming break in the atmospheric conditions taking the form of a prolonged chorus of discordant howls, repeated at short intervals for about twelve hours before the change takes place. Their predictions are almost invariably

correct, and the Zoo's head gardener can always rely on a period of wet weather when he hears this frenzied pandemonium during the daytime.

On one occasion not long ago a large timber wolf escaped from its enclosure at night, after biting through the thick wire netting of its cage. It was found wandering far from its habitation the following morning. On chase being given it bolted straight for the Zoo store-yard, where it obligingly took refuge in a travelling box in which some ostriches had recently arrived.

The Hyaena is known to all, even to those who have never seen him alive, since his fame for "laughing" has become traditional. Actually, of course, the animal's nerve-racking cry is not indicative of mirth but of excitement, and the slightest prospect of a meal is sufficient to excite him to peal upon peal of hysterical cacophony. The hyaena, like the vulture, is a beneficent creature that is seldom given its due—owing to its repulsive habits. There is no doubt however that disease would be more rife that it actually is in certain tropical countries were it not for the scavenging propensities of the hyaenas. The animals' insatiable appetites often extend their activities to inroads upon cemeteries—hence their unpopularity. The hyaena's most striking characteristic, apart from its laugh, is its power of jaw, and at the Zoo it will habitually crack up horse bones discarded by lions, and snap the thick handles of brooms as a man might a match stem. Sometimes this faculty for bone cracking takes a horrible form, trapped hyaenas having been known to gnaw off

their hind limbs in order to regain their liberty. Although of a skulking and cowardly temperament—never attacking man save in “mass formation”—hyaenas are quite attractive when young. In the cub-stage they are sometimes adopted as pets. Sooner or later, however, the hyaena’s true character asserts itself, and the growing cub is dispatched in a strong box labelled, “Live animal—With care—The Zoological Society, Regent’s Park.”

The Kinkajou of British Guiana, a member of the racoon family which when tired of hanging from a branch at the end of its long prehensile tail climbs back, hand over hand, up its caudal appendage ; the Fossa of Madagascar, a very fierce creature resembling a giant weasel ; and the Badger, are other carnivorous inmates of the gardens, that display special activity after sunset. The badger is specially active at night, and one of these animals, a native of Yorkshire, received at the Zoological Gardens on a certain afternoon in a dull, sleepy condition, escaped from its cage on the very evening of its arrival. A search-party immediately set out but with the light failing soon had to give up. Early the following morning the Marylebone police were advised that a wild and ferocious-looking animal had been observed in their district. A taxi-driver in fact reported that he had chased the creature in his vehicle for several hundreds of yards along Baker Street. The animal was eventually located by a police constable, who was attracted at three o’clock in the morning to the public-house, appropriately named “The Yorkshire Stingo,” owing to the exceptionally powerful chorus

of feline cries that arose from the neighbourhood of that hostelry. On arrival there, he found the house surrounded by all the stray cats of the neighbourhood who, with arched backs, were occupied gazing into the area where the badger had taken refuge, and from a safe distance were giving the thoroughly cowed wild animal "a bit of their minds." The constable hastened back to the station and reported the matter to his superior officer. The cats were moved on with commendable promptitude, the Zoo authorities were communicated with and the animal was recaptured. When presenting this adventurous badger to the Zoological Society its donor informed one of the curators that prior to its capture it had walked clean through a pack of foxhounds after injuring several of them.

A large number of rodents are abroad by night, when they are immune from many of their enemies, especially their arch foe—man. Some are sparing drinkers, and subsist for moisture upon dew or succulent vegetation which of course is at its best at night. An undesirable unofficial exhibit which is much in evidence in the Zoo after dusk is the rat, and a keeper accompanied by a number of well-trained terriers, goes round the gardens nearly every night picking off the vermin with a rifle. The various wild animals have become quite accustomed to the shooting, and are unmoved by the shots that may whistle overhead. The anti-rat staff annually account for a bag of over five thousand.

The beaver does much of his best work at night and if on a "rush job," such as the completion of a

lodge, before the advent of winter, will toil on by moonlight or in pitch darkness without offering any comment on the desirability of a shorter working-day.

In the Small Mammal House a number of interesting little rodents get out of bed just as the exit turnstile clicks behind the last visitor. Rats, voles, and mice all become busy, especially the lemming which has made itself dreaded by its periodic migrations. Food is the goal aimed at by these wholesale movements of this animal. Authentic stories are told of these rats moving across leagues of country in the form of a living river, only comparable to the marches of the Central African ants. They surmount all obstacles, eating as they go, and though much harassed by wolves, foxes, stoats, and hawks, eventually reach the sea where thousands find a watery grave. The classic legend of the grain-hoarding bishop who was eaten by rats in a castle on the Rhine is not incredible in the light of some more recent and reliable lemming stories.

The most fascinating of the nocturnal rodents are the little Jerboa rats, represented in the Zoo during the daytime by a sleeping box with a tuft of straw protruding from its entrance. In size the jerboa compares with a very big dormouse, but has larger ears and is mounted on stilt-like legs, and furnished with a long tail, without which it would fall forwards upon its nose. All the usual movements of a mouse engaged in its toilet are rendered peculiarly grotesque in the case of the jerboa, by reason of the creature's lanky hind quarters and minute fore-limbs. Jerboas



Facing p. 298.

JERBOAS AND PORCUPINE.

are found in Eastern Europe, South-Eastern Asia, and Africa, always frequenting barren sandy wastes with which they harmonize perfectly in colour. They move in a series of long hops—leap following upon leap with lightning rapidity, so that the animal appears to drift over the sand like a piece of wind-blown thistledown. With each leap it is able to cover a distance exceeding twelve times its own length, and only a swift grehound, cheetah, hawk, or rifle bullet can secure a jerboa when it is in full flight. During the war it was a not uncommon practice to construct desert roads of wire netting, several thicknesses being superimposed one upon the other. The jerboas soon learned that such a road could be used as a roof to their underground passages, and many a predatory bird and beast watched them “so near and yet so far” from the upper side of the road, suffering all the agonies of a Tantalus.

The only jerboa of any size is the so-called Cape Jumping Hare, which resembles a hare with kangaroo-like hind quarters. It lives, and may continue to live, in South Africa, until stamped out as a foe to agriculture.

Porcupines are often abroad by day but show to best advantage at night. They are mostly powerfully built burrowing animals of typical “guinea pig” form, but sometimes they attain the size of a large cat, and they invariably have the upper portion of their coats covered with stout bristles or spines, some of which may attain a length of eighteen inches. The spines are an effective defence against most of its enemies, and early natural histories recount how the

"porcu-pig" shoots its quills like arrows at its foe. What actually happens is this: By a contraction of the skin, the spines are made to stand erect suddenly with a loud rattling sound, and the effort dislodges old quills, the roots of which have withered. Thus it happens that a dog or even a leopard sometimes carries away a bouquet of quills in his nose, and more than one keeper has temporarily retired from the public gaze with a flight of cast-off spines embedded in his ankle. Some of the quills, especially those of the tail, are hollow, and when shaken give out a shrill, musical "whirring" sound, which is believed to act not only as a danger signal but also as a "love call." The big Indian porcupine is the best-known form. It is a handsome beast, the dorsal quills being banded alternately with black and white. Tropical America knows three species of tree porcupine, and examples of these may often be seen in one or other of the small mammal houses. The spines are mixed with black hairs and climbing is facilitated by the provision of a long prehensile tail.

Another interesting nocturnal rodent is the Viscacha of the Argentine pampas. Many animals, as we know, have the hoarding instinct largely developed, but in the animal in question the collecting mania is carried to quite amazing lengths. Viscachas live in companies of twenty to fifty, constructing underground "villages" of complex architecture. Safe in their subterranean fortifications they intimidate predatory beasts above ground by terrific growlings utterly disproportionate to the size of the animal emitting them, and which have

been compared to those of a bear. The most striking feature of the "viscacherie" is, however, the remarkable collection of oddments, which is arranged on the top of the mound covering the "village." The bones of cattle and dogs, thistle tops, nuts, shells, eggs, seeds of all kinds, watches, spurs, whips, buttons, and cigarette ends, have all been collected from such sites. The object of this collection of quite useless "treasures" is yet to seek.

Amongst the insectivores, the majority of which are nocturnal, the Cobego or Flying Lemur is the most interesting of all those that have been inmates of the Zoo. Like the flying squirrels and phalangers it is furnished with a skinny membrane, stretching from knee to elbow, by means of which it parachutes or planes from tree to tree in a downward direction. The animal which prefers fruit and leaves to insects, has been recorded to have covered over seventy yards at a single leap. It produces but a single young one at birth, the newly-born aeronaut riding spread-eagled upon its mother's back.

A common native insectivore sometimes housed in the gardens (but which does not take to captivity kindly) is the diminutive Common Shrew. It is a mixed feeder relying chiefly upon insects but sometimes raiding bird nests, and often attacking worms three times its own length. It breeds in the autumn, notifying the fact by littering country roads with its dead, slain in battle. The insectivores although inconspicuous and modest beasts seldom stirring abroad in the publicity of daylight hold several of the world's records. The Pigmy Shrew of this country is

the smallest mammal known, measuring no more than two inches from snout to tail ; the tailless Tenrec of Madagascar is the most prolific, producing twenty or more young in a single litter, whilst the mole is the most expert miner.

Amongst the Bats the large fruit-bats or “ flying foxes ” of India are easily exhibited in captivity. At night—or on a dull day—the bat collection wakes up and performs extraordinary antics, when they engage in fierce arguments with each other over the dinner-table. In their native haunts they provide the stranger with one of the evening sights, as bat after bat alights upon some specially desirable tree. Their fights to secure the most comfortable places from which to “ strap hang ”—head downwards—are responsible for a greater uproar than has ever been emitted from any rookery. The Fruit-bat does a good deal of damage to crops but the native farmer gets his own back for the animal is good eating and is regarded as a delicacy in many parts of India.

Although a certain number of bats are a menace to agriculture, and a few known as vampire-bats are addicted to blood-sucking habits, the majority do a vast amount of good, devouring quantities of disease-carrying insects. Owing however to their goblin forms, uncanny movements, and nocturnal habits they are sorely misunderstood, and it is impossible to persuade the general run of mankind that they are up to any good. This is specially the case in country districts where the “ flitter mouse ” is still the subject of foolish legends, and die-hard traditions. The bat himself, happily unconscious of the fear he inspires

pursues his way of life, and does a vast amount of good. The creature stands high in the scale of life, his so-called wings being merely hands with greatly attenuated fingers, with the web between each digit exaggerated to form an effective plane. His sense of touch is developed to an extraordinary extent, the wing membranes and the various leaf-like developments of the face being highly charged with nerves, which at once apprise him of any obstacle in the immediate vicinity.

The Sloths, Ant-Eaters, and Armadillos are all more or less nocturnal animals, characterized by having no front teeth. The South American leaf-eating sloths are amongst the most arboreal of animals, spending almost their entire existence in trees from which they hang back downwards with their faces perpetually directed skywards, clinging on with their enormous claws which serve them as grappling irons. If placed on the ground "right side up" they are all but helpless and drag themselves about in a purposeless fashion painful to behold. The sloth has been a byword for sluggishness and the average good day's march for one of these animals amounts to less than a hundred yards. Compelled by circumstances, however, it can move at an astounding pace along the branches of trees. It is likewise a good swimmer and can cover a mile of water in half an hour. Asleep it invariably rolls itself up into a ball when it is said to be quite inconspicuous, harmonizing with the huge curtain-like festoons of lichens draping the forest trees. The only sound it ever utters is a bleating cry, which under the stimulus

of pain or fear rises to a prolonged wail or moan. Although sloths seldom live long in captivity, in their native forests they are said to attain a very old age, surviving severe injuries from their enemies the jaguars, harpy eagles, and boa constrictors.

The Armadillo of Central and South America bears a quaint superficial resemblance to the common garden wood mouse. It is a very nocturnal animal, but may often be seen to advantage at the Zoo on a dull day. Its hair is strangely modified to form overlapping plates, arranged in bands, so that the entire creature is enclosed in a plastic and very efficient suit of mail. In some cases the plates covering the chest and shoulders are united to form a bony cape, whilst usually many true hairs are dispersed over the body, between the armour joints. The major portion of the under surface is hairy. In some extinct armadillos of Patagonia the armour was formed of a single piece, much like that of a tortoise, and must have looked decidedly impressive when carried about by a creature nearly as large as a rhinoceros.

Armadillos are greatly addicted to burrowing, and certain parts of the Pampas are said to resemble a gigantic gruyere cheese, thanks to the house-hunting efforts of these animals. They are kindly disposed omnivorous creatures, and in captivity can be let loose in the same run with animals of widely different natures such as monkeys and squirrels.

The Ant-eaters are represented by three species, of which the largest is the Giant Ant-eater of the swampy forest regions of Central and South America, an animal adapted solely to the destruction of ant

nests and the extermination of their occupants. At a hasty glance it appears to be a jumble of skunk, bear, and bird. It has the skunk's overwhelming tail, bruin's clumsy body and massive limbs, whilst its long pointed head is more suggestive of that of a bird than a mammal's. Yet, wild anomaly as it would appear, after only a superficial survey, every portion of this strange beast is beautifully "in tune" with its surroundings and notions of happiness. Hundreds of thousands of years spent sucking rather than chewing food have resulted in the ant-eater's lips becoming fused together until a mere key-hole opening is left, just large enough for the extrusion of its long whip-like tongue. There is not a vestige of a tooth throughout its foot-long jaw-bones. When a meal is desired the ant-eater makes for one of the mountainous communal nests of the white ant and besieges it with his powerful fore-claws. This is a "notice to quit" for the panic-stricken inhabitants, and they pour forth, only to be met with by a long lashing tongue. Such as adhere to it—for it is covered with a sticky saliva—find a last resting place in the ant-eater's interior. The ant-eater's flesh is said to be very palatable, but jaguars and dogs rarely attempt to attack him more than once, for his huge hug is as deadly efficient as that of a bear. Man however, with rifles and poisoned arrows is fast exterminating this strange beast which does an immense amount of good in an ant-ridden land. The ant-eater is normally nocturnal and much given to keeping itself to itself. The single offspring, a miniature replica of the mother, is carried for a time

on the parent's back, and has been reared in semi-captivity at a research station in South America.

Zoo ant-eaters are usually mild and inoffensive, and do well on a diet of milk, eggs, boiled fish or finely-shredded raw beef. They are clumsily playful in each other's society, but show little or no special friendliness towards their keepers. Brain is not the ant-eater's strong point. His crowning glory is his tail which serves him as a sunshade by day and a blanket by night. His voice is a feeble mew, becoming harsh and strident under the stress of great emotion. The late Frank Buckland, when curator at the Zoo, once took a full-grown ant-eater to the gardens in a four-wheeler. An argument arose *en route* and the redoubtable naturalist, although a man of huge proportions, eventually staggered from the vehicle with very decided views on the subject of his charge's power of embrace.

The Aard-Vark or Earth-Bear of the sandy wastes of South Africa, is another large nocturnal animal, devoid of front teeth, which has frequently been an inmate of the Zoo. In general appearance the creature resembles the ant-eaters, but its tough skin is but sparsely covered with hair, and its long, narrow head with large, pointed ears terminates in a pig-like snout. Its tunnelling feats are remarkable, and to see it literally dive into the solid earth, forging ahead with its fore-feet, and flinging the slack behind with its nether limbs at a rate that two hefty men armed with shovels would be unable to keep pace with, is a sight not easily forgotten. It lives

almost entirely upon white ants, tearing down the insects' towering earth castles, and licking up the panic-stricken termites with its whip-like tongue. At the Zoo, where it is fed on finely chopped-up meat, it lives half buried in the earth during the daytime. It shows itself, however, a very lively beast after dark when it will run and even jump in a clumsy fashion, and has swept more than one keeper off his feet with a single blow of its long cylindrical tail. At the Pretoria Zoo a dog-cart puts out twice a week for the sandy wastes in the neighbourhood, and brings back in a zinc tank a consignment of termites for their dozen or so "earth-bears" who combine monastic seclusion with a love of good living.

The last of the nocturnal mammals to come under review in this chapter are those known as monotremes. They might be described as "Bird-Beasts," for they resemble birds in not only having a very low blood temperature, but also in the fact that they lay eggs. They are, however, true if primitive mammals, for they suckle their young, and their bodies are covered with mammalian fur or spines.

The best-known of the group of egg-laying mammals is the Duck-Billed Platypus of Tasmania and Australia, in which the muzzle is produced to form a broad skinny beak. Its body is covered with fur, and the toes of the feet are webbed. Being prized for its flesh and fur it is fast becoming extinct, but of late years several have been exhibited in Sydney, and one lived for a very short time in the New York Zoo. The latter specimen which cost the authorities £600, was exhibited for one hour only per day, but

even this amount of publicity apparently proved too much for it.

In the wild the duck-bill is a shy little beast rather like an otter in shape, and with all the otter's skill and agility as a swimmer. Duckmole is one of its popular names, since it excavates burrows, twenty feet in length in the stream banks. There are two exits, one above the water line and one below it. At the end of the burrow, cunningly blocked at intervals with mud plugs, is a round chamber in which a bird-like nest is built. Here the round white eggs—usually two in number, are laid and hatched. The newly-born young are blind, naked, and all but shapeless. But teeth are present, and in both sexes there is on each hind-foot a spur connected with a poison gland. When able to run about they are said to make the most delightful pets, romping about like kittens, and never attempting to use their spurs—retained in maturity only by the male.

The spiny Porcupine-Ant-Eaters or Echidnas, one species of which hails from Tasmania, and the other from Papua, are other egg-laying mammals. They take more kindly to captivity than the duck-bills, and a large New Guinea specimen, which owing to its thoroughly nocturnal habits never emerges from its sleeping box during the daytime—unless hauled out for inspection by its keeper—has been an inmate of the Rodent House in our gardens for the past nineteen years. Like their duck-billed relative they are addicted to burrowing habits, but differ in being essentially terrestrial, and instead of eating fresh-water molluscs they dig up ant-hills, licking up the

insects with their long worm-like tongues. When attacked or feeling shy they at once roll up, hedgehog fashion, and present formidable "battle-backs" to the intruder. Whereas the duck-bill can relieve its feelings in a feeble growl, the echidna when disturbed merely hisses in a snake-like fashion.

There is no more interesting exhibit at the Zoo than that remarkable avian, inhabitant of New Zealand, called the Kiwi, the wings of which, hidden beneath very coarse hair-like feathers, are reduced to such small proportions as to be quite useless for the purpose of flight. Unfortunately night is the time to see the kiwi, for in the Zoo he sleeps by day hidden under a thick pile of straw. What the kiwi lacks in wings he gains in having very long legs with which he can run at a very high speed when alarmed. Usually, however, he creeps about in a burglar-like fashion, and with his long slender bill, which bears at its tip a pair of highly sensitive nostrils, searches for worms and beetles with a fussy sniffing noise recalling that of our home-grown hedgehog. The feet of the bird are very massive, and with them he stamps upon the ground, and induces the worms to come to the surface, deluded into thinking that rain is falling. In the mating season the married kiwis are very retiring in their habits, but the family cares once over they become more sociable and congregate in small flocks. The nest is a round chamber at the end of a long burrow and is roughly upholstered with grass. In it two eggs are laid. They are enormous for a bird no larger than a domestic fowl, being each equal to a quarter of the layer's own weight. The cock takes

upon himself all the domestic and nursing duties, and during this time gives vent to his emotions in a loud note from which the bird's name is derived. Being much esteemed for food by the Maoris, the kiwis are fast joining the other larger wingless birds in their extinction, and are retreating to the densest scrub upon the mountain slopes.

Owls are other night-birds that the Zoo public sees under a disadvantage, for during the daytime they sit on their perches almost motionless, and attempt to impress the visitors by a dignity of manner which they carry to such excess as to appear almost ludicrous. The owl's eyes, like those of cats, are provided with vertical pupils, which expand at night, when the birds become full of purpose, and would, if given their liberty, be only too willing to assist the official rat-catchers. By day they are open to persecution by small birds, but at night have on occasions been known to attack man. All owls are by nature fierce and savage, and in captivity the greatest tact and kindness will seldom render them well-disposed towards their owners. Owls build upon the edges of inaccessible cliffs, in rock fissures, caverns, dense pine forests, and such ready-made snuggeries as disused chimnies, belfries, and barns. The eggs are laid at intervals, many days often elapsing before the entire clutch is laid. It happens, therefore, that the young do not all see light at once, and one may frequently find a brood of young owls nicely graduated from the chick of only a few hours old to a comparative veteran of at least ten days who has helped in the incubation of his younger brothers.

and sisters. The owl is perfectly adapted to enjoy its particular way of life, for its thick, soft plumage enables it to cleave the air without a sound and to descend upon its quarry with the sudden stealth of a cat. The four tiger-clawed toes are so jointed that they can form two opposable pairs—a four-pronged grappling-iron that at once transfixes any animal it strikes. When a small creature such as a rat or mouse is the victim, the two pairs of claws enter it from opposite sides, and meeting in the heart render death instantaneous and the carrying away of the body an easy matter. Owls have a curious habit of regurgitating the more solid portions of their meals, bringing up the bones of mouse, bird, and fish in the form of dry pellets. Thus the discerning visitors when reviewing the Zoo owls may, by an examination of the pellets littering the cage, ascertain at a glance the nature of the last meal enjoyed. These pellets form a bedding, warm no doubt, but unsavoury. At the Smithsonian Institute seven hundred owl pellets were analysed recently. They yielded the remains of 1,596 mice, 140 rats, 60 shrews, and 40 other small mammals, and a few birds. To this day the owl is in many countries regarded with superstitious dread and accredited with all kinds of black magic. Its nocturnal habits and especially its voice are partly responsible for this. The harsh screech of the barn owl, the deep hoot of the eagle owl, and the loud "tu-whit-tu-whoo" of the tawny owl, all ring somewhat eerily on a still night, even to educated ears.

One of the largest of owls is the Eagle Owl of

Europe, which has been known to kill fawns and is very destructive to rabbits and hares. One of the smallest is the little American burrowing owl. Many pretty stories are told of the communistic spirit displayed by the bird, for prairie marmots and rattlesnakes are said to share amicably the same burrow with it. Actually this apparent instance of communism—like certain other experiments of its kind—makes for anything but Utopia. The owls and snakes certainly billet themselves upon the prairie marmot, but there is little love lost. The owls take toll of the baby marmots, and occasionally young snakes ; the marmot varies his diet of roots with a dish of owls' eggs ; and the snake helps himself to birds or beasts as his appetite dictates.

A quaint group of nocturnal birds, somewhat resembling the owls in plumage, and closely akin in many other ways, is represented in Regent's Park by the Nightjars and Frog-Mouths. The latter present such an enormous gape that their mouths threaten to meet at the back of their heads. They occur in New Guinea, Malay and Australia, and feed at night on mantis and locusts, which being diurnal are seized and given a rude awakening. During the daytime frog-mouths sleep so soundly that they can be lifted from their roosts without awakening from their slumbers.

A certain number of snakes are slightly more restive at night than by day. With the exception of these, of the geckos, certain toads, and the blind cave-newts of Carniola, very few of the inhabitants of the Reptile House are specially lively after closing time.

The gecko lizards—natives of nearly all warm parts of the world—are interesting to watch when disturbed by the light of a torch. During the daytime they seldom move from the walls or glass panes of their cages to which they remain attached by means of the adhesive pads with which their feet are provided. They are entirely different animals at night, however, when they display as much activity as do the wall lizards on a bright summer afternoon. Many geckos are arboreal, living in the bark of trees by day, whilst a large number frequent houses. The different species of house geckos keep themselves very much to themselves, and Col. Tyler has observed in India that the dark cellars may be the resort of one species, the roof of another, while the crevices in the walls may be exclusively occupied by a third species. However, at night they issue forth in quest of insects and may be found mixed up together in the same spot ; but on the slightest disturbance, or when they have done feeding, they return hurriedly to their particular hiding places.

Do fish sleep ? This is a question that is continually being asked, and the correct reply is that whilst a number never appear to rest, a few most certainly do so. Shortly after closing time some of the inhabitants of the Aquarium such as the thoroughly nocturnal cat-fish awake from their slumbers ; others, however when no one is present to admire them, retire to rest. The perch, gay and sportive by day, sink to the bottom of their tank, and fall asleep resting on the ground in an uncomfortable, upright position. The wrasses not only seek the aquarium floor at night but

lie flat on their sides, a habit which when indulged in by a somnolent specimen in the daytime has prompted a host of well-meaning visitors to inform the long-suffering keeper on duty that the fish is dead.

CHAPTER XI

SPRINGTIME

THE spring is the accepted time for the majority of animals to search for a mate, and, having succeeded in the quest, to start house-keeping in earnest. The Zoo is consequently in the spring a resort of special interest to the visitor seeking instruction as well as entertainment. From March onwards until early June the gardens are aglow with activity, and on all sides the "life force" is expressed with often indescribable beauty and not a little romance. From the spectacular point of view the mammals are far behind the birds and fishes in their love-making, but still no one can watch a lion seeking to ingratiate himself with his lady without admitting that his courtship has a charm and dignity of its own. Spring is of course the time for donning lighter clothing. At the Zoo this is done very gradually, and as the influence of the sun begins to make itself felt one may see at all hours of the day wisps and even bundles of hair drifting about the gardens. The camels, deer, bison, bears, and wolves are all thinking of their new summer suitings, and at this season the zoo sparrows, obsessed with their housing problems, seize upon the cast-off clothing

with alacrity. All the northern mammals change their thick winter coats for lighter garments as the air becomes more genial, and they are, it must be admitted, far from decorative in the process. The majority change their furs merely for the sake of comfort, but a few do so for a more subtle reason—camouflage. They must change colour in order to match the landscape, lest they become fatally conspicuous. This is so with the arctic fox, the mountain hare, and the ptarmigan. As in their native land the snow recedes, and discloses brown rocks and grey heather roots, so these creatures change fur or feather to blend with their surroundings. Nature's laws are not easily repealed, although there is no need for camouflage in the sheltered security of Regent's Park menagerie. The deer not only shed their coats but also their antlers. Every spring sees the proud wapiti and a host of other bucks shorn of the branching horns which lent them so much dignity during the summer and winter. A deer in good health sheds both antlers in a night, but if a little "off colour" may present a lop-sided head-dress for several days. When he is quite defenceless his better half, with, perhaps the memory of past bullying behind her, may take advantage of his helpless state. But not for long, as the new antlers begin to sprout almost immediately. At first, although protected by a thick "velvet," they are very sensitive, being highly charged with blood-vessels. As the summer approaches the blood recedes, the velvet peels away in strips, and the antlers stand revealed as many branched, iron-hard weapons with

which their owner will fight for his lady-love later in the year.

Spring is the season when a number of animals that lie up during the winter in a semi-dormant condition awake from their long sleep and entertain the visitors by their antics. The Alpine Marmots, for instance—curious little rodents characterized by their fat rounded bodies and long tails—spend the whole winter in profound slumber. They live in deep burrows and their sleep is unbroken from November to April. In the wild state they collect in large companies on mountain slopes, each colony having a sentry posted to give warning of impending danger. At the smallest cause for alarm the sentry gives a piercing whistle-like scream, which is taken up by the other sentries, whereupon all the marmots take cover in their burrows. The European tortoises likewise dig themselves in late in the year when the weather becomes unfavourable, and do not reappear until about the middle of April. Even the two-hundred-year-old giant tortoises which are kept at a temperature of over seventy degrees throughout the winter show marked activity in the spring when they begin to take a lively interest in their visitors, begging from those provided with buns and cake, an untortoise-like diet for which these giants have recently developed a liking. Spring is likewise the time when many of the Zoo animals know the joys and troubles of family life. It is amongst the birds that the greatest activity is displayed, and amongst the majority there is an outbreak of brilliant colouring, voluptuous song, and extravagant deportment.

Even the sparrows are less dowdy and more pugnacious than usual. In every bird-house and aviary courtship is in full swing. With the finches and parrots it takes the form of pretty flirtations and flutterings on the part of the males, but in some forms, such as the pheasants, it is carried to more Elizabethan lengths. The strange performances of the male golden pheasant, the most magnificent representative of his tribe, are specially beautiful and entertaining ; for, whilst dancing round and round his "intended," he expands his bright orange, yellow, scarlet, and blue feathers thereby presenting one of the most brilliant sights to be seen in nature. In May the fights between the male ruffs in the wader's aviary attract attention. In these combats the birds stand with their shield-like ruff of feather on the neck erected, and thrust at one another with their long, sharp bills. Although appearing exceedingly ferocious these duels for the possession of the females result in little real damage.

The advent of spring causes great excitement in the ostrich house. In April the emus and cassowaries may be observed performing their frenzied love dance, a wild fandango noticeable for the "high kicks" which are indulged in by the males with such "go" as frequently to result in their falling over on their backs. The females are as a rule much larger birds than their admirers, and usually receive these vigorous attentions—at least in public—with the most supreme indifference. The love affairs of the ostrich take place later than the other inhabitants of the house and are not in full swing until the middle of

May. He may then be seen bent almost double, until the head and the tail feathers almost touch. The wings are at the same time fully extended, and the swain gives vent to his feelings by emitting a hoarse roar, a demonstration which has the dual object of pleasing the lady and inciting any rival males to combat.

Ostriches frequently lay eggs in Regent's Park, but no success has as yet been achieved in hatching them. The mother is often hopelessly clumsy and has often been observed to tread on her egg and smash it.

The spring affects many of the Zoo birds from both jungle and desert. A few, however, refuse to be inspired to song or dance so early in the year, and await their own native spring—our autumn—before giving way to their emotions. It is not, for instance, until late in September that the æsthetic Australian bower birds start building their bowers, in which they perform their elaborate and ceremonious courtships. There are several species of bower bird, and each has its particular idea of what constitutes the ideal bower, and rigidly upholds the traditions of family architecture. In its construction one species may make use of nothing but sheep's wool and cotton seeds; another may prefer feathers, shells, or pebbles, whilst yet a third may delight in flowers, which, when withered, are immediately renewed. In a corner outside the reptile house is a pond in which the eggs and tadpoles of our common frog and toad are exhibited in the spring. The eggs of the former are obtainable usually towards the end of March, those of the latter at least

a fortnight later. Unlike the frog which will deposit its eggs in any pool or puddle, even in those which are almost certain to dry up before the tadpoles have begun to develop, the toad in the wild state takes the greatest trouble in choosing a locality and will travel long distances, surmounting every conceivable obstacle to reach a special pond the "rendezvous" of all the toads for miles round.

In spite of the fact that this Zoo pond is used as a receptacle for paper bags and orange peel by a particular type of visitor, it must answer the requirements of our common toad, for not only do its eggs match out but in it the majority of the tadpoles successfully complete their metamorphosis.

Although the inmates of the aquarium are for the most part silent, they are very susceptible to the influence of spring and almost every tank is stirred to its depths. The great majority of the fish take on brighter colours at this season, especially the males, and everywhere is to be seen in progress courtship, bitter rivalry, conquest, defeat, house-building and home-making. The quaintest examples of home-making are to be observed in the tropical hall. The gaudy perch-like South American and African fish called cichlids are frantically busy providing suitable chambers for the protection of their prospective young. The nest or nursery is the work of both parents and takes the form of a deep circular depression in the sand in which the eggs are laid. In the construction of these nurseries the fish take up mouthfuls of sand which are dumped in the neighbourhood. Unfortunately it often happens that two

sets of newly-wedded cichlids elect to keep house side by side. The natural tendency is of course to dump the rubbish no further than is absolutely necessary. What can be easier than to pitch it into the pit just over the garden wall ? The people next door retaliate, and the situation rapidly becomes tense for neither nest makes headway in proportion to the labour devoted to it. It is not difficult to guess that it is only a question of days before the neighbours come to open warfare. Under peaceful conditions the cichlids bring up their family in the parental pit, jealously guarding their offspring. Not until the baby fish are several weeks old are they allowed to stray far from home. Should they attempt to do so they are brought back at once—held securely in the parental mouth.

The habit of sheltering baby in the mouth is carried to extremes by the mother of a Nile cichlid which harbours the eggs, and, for the first few days after hatching, the young, in her mouth.

Another aquarium nest-builder who has a busy time in the spring is the Chinese paradise fish. To the male falls the major portion of the parental duties for not only does he build the nest which consists entirely of sticky bubbles blown on the surface of the water, forming a foaming pancake, but he collects the eggs on their being laid into his mouth and carries them, one by one, to this curious floating home to which they adhere. The mother if given the opportunity would devour the eggs. So highly developed, however, is the paternal instinct, that the father not only watches over his bubbly abode until the young

hatch out, but for several weeks after protects his offspring from their cannibalistic mother.

A good deal of excitement prevails at this season in the cold fresh-water tanks. The trout sometimes elect to form depressions in the gravel at the bottom of their aquarium, the pike in their love-making are apt to disfigure one another by their bites, and the sticklebacks become unusually beautiful and active. The male of the common three-spined stickleback, or "tiddler" as he is better known to the juvenile angler of the London parks, assumes a dazzling livery of emerald green, blue and crimson, and builds barrel-shaped nests formed of tufts and weeds, cemented together by a gum which he secretes from his kidneys. Once the nest is formed he sets out in search of suitable wives, a procedure which leads to the most terrific battles amongst the rival suitors. The wives are in turn, more by force than persuasion, led to the nest where the eggs deposited are defended against all comers by the polygamous husband.

CHAPTER XII

BIRDS OF PREY

TO keep an eagle in captivity and at the same time to accommodate him with sufficient range to exhibit properly his tremendous powers of flight is beyond the scope of the most perfect zoo. At the same time we need not lavish too much sympathy on the bird as he is an exceptionally lazy creature and so long as regular meals are forthcoming is contented with his lot—wherever it may be.

The eagle is to the avian world what the lion is to the mammalian. He is represented as a device to express heroics, and has been exploited on thousands of occasions by story-tellers, ballad-mongers, inn-keepers, and the college of heralds.

Eagles enjoy a world-wide distribution and normally haunt high cliffs and mountain ranges. As a rule they bring up their young in spartan fashion, seated on the cold stone amid a very unkingly mess of hare bones and other debris. The only eagle which can be considered a native of the British Isles is the Golden Eagle, which breeds regularly in the Scottish Highlands. It is very rarely seen in England. A specimen recently

presented to the London Zoo was, however, found in Lincolnshire. It was captured under somewhat mysterious conditions. According to its captor it had been seen flying in the neighbourhood at a great height for a fortnight prior to being picked up in a more or less dazed condition following the firing of a gun. It was at first supposed that the bird had been shot, but on examination it showed no signs of injury. The golden eagle is a very long-lived animal, there being a record of a specimen thriving in captivity for one hundred and four years.

Hair-raising adventure stories of eagles carrying off infants and lambs have multiplied apace before and since the classic legend of Ganymede. The eagle of fact is usually content with hares and game birds, and will in confinement readily accept a cut from the joint. The King of birds even shows some capacity for semi-domestication and the Zoo keepers enter the eagles' cages many times daily and are never armed with any more deadly weapons than broomsticks and pails. When it is found necessary to remove an eagle from one cage to another two keepers advance upon the bird, cover its head with a hood, and quite calmly proceed to take control of the wings.

Zoo eagles occasionally vary their diet with a few live rats. A youthful and unsophisticated rat sometimes enters the cages, and runs the gauntlet of half a dozen before being pounced upon. All the eagles are so uniformly picturesque that it is difficult to pick upon any demanding special notice. The largest is the rare so-called monkey-eating eagle of

Brazil, which is said to prey upon monkeys and sloths. It has only once been exhibited in captivity, and that once at Regent's Park.

To the utilitarian, the vulture is a vastly more interesting bird than the eagle. He however seldom gets his due as a first-class sanitary inspector, owing to his necessarily unsavoury habits and repellent appearance. His head, neck and feet are bare, a cleanly provision of nature, since the bird in the course of its scavenging would soon befoul any feathering liable to be brought into contact with a putrefying corpse. Vultures abound in the hot desert countries, and subsist entirely upon carrion. A large animal suddenly meeting its death on the scorching wastes of Egypt, the Karoo, or the veldt is reduced to a skeleton by the vultures in a few hours. Vultures contrive to congregate together much as sea-gulls do when following a fishing fleet. The vulture soars high in the air, sweeping all below it with its eyes. On seeing another of its kind flying purposefully in a given direction it at once follows. The other vulture is of course following in his turn another vulture, who is in the wake of a colleague who has sighted a meal. Thus within half an hour of the first vulture notifying a find, hundreds of birds meet in a struggling mass of beaks and claws, and at once remove a public nuisance, which if left to decay might spread disease and pestilence throughout a large area. The ancient Egyptians were quick to recognize the vulture's worth, and went so far as actually to deify the creature.

Only two vultures, both natives of South America,

can lay claim to any natural beauty. They are the King Vulture, and the huge Condor which has an extent of wing of over twelve feet. The "King" has a scarlet head and an orange wattle, whilst the condor hides its raw-looking neck in a snowy Elizabethan ruff.

Between the true eagles and vultures proper are all kinds of intermediary forms, and no region tropical, temperate, or arctic, is without its so-called birds of prey. A typical intermediary is the Osprey, a regular visitor to Scotland, which lives exclusively on the fish it marks down whilst soaring at a great height and seizes in its claws after striking the water with terrific force. A conservative bird, it comes year after year to the same site where it superimposes a fresh layer of building material composed of tree branches, offal, bird lime, etc., upon the remains of the previous year's nest. In this way a structure imposing but evil-smelling is gradually raised, and many instances are recorded of nests that in the course of years have towered ten feet or more above the tree-tops—eventually succumbing to an exceptionally violent gale.

As a rule birds of prey do not breed in captivity. At the Zoo the Egyptian vultures often indulge in nest building, and even lay, but the eggs have unfortunately never been hatched.

The Secretary Bird of South Africa is an imposing creature standing as high as a large crane, and derives its name from its tail feathers which resemble a bunch of pens. For many years it was a bone of contention amongst naturalists as to whether the



SECRETARY BIRD

Facing p. 326.]

... crushes a Puff-adder.

creature should be classed with the cariamas of Brazil, or with some extinct feathered giants that once haunted the plains of Patagonia. In recent years the conclusion has been reached that the "secretary" is a bird of prey—virtually a vulture on stilts, combining the power of an eagle with the legs of a stork.

Comporting himself with an exaggerated dignity well in keeping with his Napoleonic eye and Cæsarian nose, the secretary goes where others fear to tread, for he is one of the few birds that can stand up to a snake. Although willing to eat carrion on occasions, he is pre-eminently a serpent-slayer, and as such has enjoyed immunity throughout South Africa. In dealing with such deadly foes as puff-adders or cobras he is very wary, and approaches his victims by means of an ever-contracting series of concentric circles. He makes this spiral circuit with a dignified high stepping action, prepared to strike at a moment's notice. At the same time his great wings are in readiness to act as shields, or even to serve as weapons, for each has a sharp bony knob situated on the joints. Little by little the secretary decreases his distance between himself and his quarry, and then suddenly, when just within striking distance, deals a lightning death-blow with one of his hammer-like feet. After a brief interlude has elapsed, and when the bird has made certain that its victim is dead, the dreaded reptile is swallowed whole. Despite his dignified appearance, his home is but a slovenly built structure composed of a few dead branches piled up in some bush a few feet from the

ground. Here the lady secretary lays two or three large eggs, which in time yield budding secretaries—the most grotesque scraps of life that ever wore feathers.

CHAPTER XIII

THE AVIAN BEAUTY CHORUS

FINE feathers make fine birds—but not necessarily tuneful ones. Without indulging in too many odious comparisons, it is undoubtedly to be recorded as a fact that not amongst birds alone but also amongst the members of a certain race of animals considerably higher in the scale of life, beauty of voice and beauty of appearance are seldom found combined in the same individual.

In the avian world brilliance of colouring goes almost invariably with a harsh, or otherwise displeasing, voice. The songsters, from that feathered Melba, the nightingale, to the tuneful piping crow, are always soberly, and often even dowdily clad. One must not expect too much, however, and even if the members of the Zoo's beauty-chorus offend the ear, we may find consolation in the splash of exotic colour which they bring to London, especially during the sombre winter months. The most beautiful birds are inmates of the Small Bird House. Here are the Birds of Paradise. For more than a century and a half the skins of these gorgeous creatures have been imported from New Guinea and the neighbouring islands, but only in comparatively recent times have the birds become really known.

The early dealers removed the legs, and often the wings, before packing the skins, and the arrival of the mutilated remains gave home naturalists much food for speculation. But the old-time naturalist was not easily beaten. If he could not hit upon the right explanations of any given phenomena, he very quickly invented some. It was formerly universally believed that birds of paradise were hatched minus legs and wings, and the males were supposed to float through the air with the long flank and tail feathers streaming behind, forming a sort of raft in which the hen nested and brought up her young. Even the great Linnæus in 1766 named a certain species "apoda"—or "bird with no legs."

Structurally the birds of paradise are nothing more than highly ornamented crows, their nests, eggs, and voices in all cases strongly recalling those emanating from our home-made rookeries. The plumage of the males is, however, very sumptuous, and in glaring contrast to their distinctly dowdy brides. Of those exhibited at the Zoo, the green, yellow, orange, and salmon pink, greater bird of paradise, the emerald green, black and yellow, twelve-wired bird of paradise, and the scarlet, white and azure-blue king bird of paradise, are the most brilliant examples.

In several forms the wings and tail feathers achieve such proportions as to render flight all but impossible. In a Papuan bird of paradise for instance the tail shafts are three feet in length, although the body of the bird is not much larger

than that of a raven. Most birds of paradise indulge in elaborate displays, when they cut the strangest capers, the males of the Blue Bird of Paradise posing before its "intended" for hours at a time—upside down. When the first specimen brought to the New York Zoo thus courted its cage-mate, the keeper dashed off to the curator's office with the news that the bird was in convulsions! During courtship most forms appear to swell to twice their natural size. Presently a line of livid colour appears down the centre of the breast, the feathers stand erect, and finally a huge halo-like crest rises from the bird's head. Failing the presence of a hen, Zoo specimens can occasionally be induced to display by showing them some bright trinket. A looking-glass seldom fails to excite them, the bird's own image doubtless being mistaken for a hated rival.

The Sun Birds of the Old World, and the Sugar Birds of South America and New Guinea, are almost as dazzling as the birds of paradise, although smaller. They have very slender bills, and long extensible tongues. The tiny feathered gems known as Sugar birds have the latter organ forked and split up into a number of horny whisks, the better to "mop up" the honey from the flowers. They require an enormous amount of nourishment, and as they will only feed in comparatively bright light, the Zoo bird-house is artificially illuminated on dull days and for some hours after closing time in the winter months, in order to prolong their meal-time hours.

No birds enjoy greater fame for brilliance of colour than the Humming Birds of tropical America.

In size and in the nature of their flight they suggest insects rather than birds. The giant of the race is but nine inches in length, but the majority are not much larger than bumble bees. The bill of a humming bird is long and curved, and the long flexible tongue is forked, the two ends being fringed with hairs. The latter organ is shot forth at lightning speed when extracting a sip of honey, or whisking a small insect into the great beyond. The wing muscles are enormous for the size of the bird, and enable it to poise in mid-air before some pendent bloom, after the manner of a hawk moth.

Almost every conceivable change has been rung upon the form of feathering of these birds. The several hundred species known are nearly all characterized by vivid metallic tints, but whereas one may appear to be all tail, another will support downy cushions on the hips, and perhaps an extravagant head-crest. The nests are as dainty as their builders. Often they are affixed to the stems of plants or hang from the tips of leaves. Moss, down, and spider webs are amongst the materials used, and the tiny pea-shaped chalky-white eggs eventually hatch out into nestlings that are naked and blind.

Some years ago twenty humming birds were exhibited in the Zoo. They were housed in two large glass cases stocked with nectar-producing flowers which were maintained at a temperature of 75 degrees F. They survived unfortunately only a few months.

The Touracous of tropical Africa are comparatively large birds which exhibit beautiful metallic tints

which, however, wash off. Some of the flight feathers are usually of a vivid crimson, and contain a curious pigment called "turacin" which includes amongst other ingredients copper. This can be reduced to a powder, and is employed for all kinds of delicate work requiring a highly soluble pigment.

The Toucans of Central and South America may be given a place in the second rank of the beauty chorus. Their colours lack prismatic sheen, but are "splashed on" with a bold and poster-like effect. The enormous bill of the toucan which is a light and porous structure, and is used for crushing pulpy fruit and purloining the eggs of other birds, is no less brilliant than its feathering. The creature never walks, but hops, producing a ludicrous effect, which is in no way reduced by its gigantic nose. When going to roost the toucan tucks its ridiculous bill beneath one wing, and covers it entirely by turning its tail over its back. The most plausible explanation of the act suggests that if the toucan's resplendent nasal organ were left exposed its shining surface might call the bird's presence to the attention of such undesirable passers-by as snakes and carnivores.

The Kingfisher, most brilliant of our native birds, is inseparable from hot summer days, luxuriant foliage and still waters. Any quiet waterway, fairly well stocked with small fish, and adequately protected from the imbecile with a sporting gun, may afford sanctuary to this beautiful bird. The kingfisher demands only peace, and a sandy soil in which to build. Failing the latter it sometimes

uses a hole in a tree or even in a rubble wall. Usually it makes a home for itself by shovelling out the sand just above high water mark, until it has constructed a tunnel from three to six feet in length, terminating in a small bed-sitting room. Here in March or April about half a dozen glossy, snow-white and almost globular eggs are laid. They are hatched out upon a mattress composed of fish bones, which the parents regurgitate in the form of small pellets. When possible the nest is built near some convenient branch. As soon as the young are strong enough they are marshalled in a single rank upon the family perch, where they sit in a solemn queue awaiting the advent of their fish rations. Only when there is a fish shortage are dragon flies and other aquatic insects acceptable. The kingfisher always keep close to the water's edge, often waiting patiently for hours on end, perched upon an overhanging branch, and with its beady eyes fixed upon the depths below, bides its time until the psychologic moment is at hand. The bird does not thrive in captivity. At the Zoo it is, however, occasionally to be seen—not in a cage, but disporting itself at liberty on the banks of the Regent's Canal. It has been known to nest in the London parks, and is a regular feature of the "bird island" on the Serpentine.

The large Australian Kingfisher or Laughing Jackass, needs no introduction for those who served overseas during the war, for its native name of "Kookaburro" stood for one of the concert parties that took one's mind off the ever present topic of

shell-fire. The jackass is a bird maligned. His gay plumage, volatile nature, and exuberant voice have led many to write him down as a feather-brained fool. He is in reality a quite serious-minded bird, and a good friend to man, since he relies for food upon rats, mice, snakes, and other creatures that scarcely contribute to the settler's peace of mind. Although a kingfisher in form, the jackass is no fisherman, and lives in the bush, often far from water.

The jackasses in Regent's Park keep up their habit of singing their morning and evening songs —a low gurgling laugh which gradually swells to a deafening cacophony that on a still day, can be heard a mile off. So regular are his times for laughing that the old colonists relied on his outbursts to tell them of approaching sunrise and sunset, and dubbed him the "settlers' clock."

CHAPTER XIV

TALKING BIRDS

NONE of the feathered folk at the Zoo have contributed so much towards the entertainment of the public as the talking birds. The majority being brightly coloured enliven their surroundings, and all can be relied upon to keep alive one's sense of humour. The cryptic phrases uttered by these birds are usually grotesquely irrelevant. On occasions, however, they may be uncannily apposite. The best known, if not the most accomplished of the talking birds are, of course, the parrots. There are in all about five hundred species of parrots—and about five million different parrot stories, only a few of which are true. The trouble with the parrot story-teller is that he usually puts an all too human construction on the bird's speech, and would have it believed that the creature knows what it is saying. But it is really only the imitative faculty of the bird, and not its brain, that is highly developed. The receptive mind of any talking bird quickly seizes upon any words or even sentences which take its fancy, provided they are brought to its notice with sufficient frequency; and the peculiar formation of its tongue, palate and larynx enables it to repro-

duce them for its own private amusement. If its performance brings a reward from its audience so much the better. It soon learns to associate a nut or a piece of sugar with its vocal efforts, and proceeds to give encores *ad lib.*—sometimes to a wearisome extent. Many curious instances of this “encore habit,” might be cited of the Zoo parrots. A classic example is that of the African Grey Parrot that was once quartered near the bank of the Regent’s Canal. Year in, year out, he listened to the bargees shouting “whoa” to their plodding horses, and in time the parrot learnt to reproduce the command with a beery hoarseness that was all too human. Over and over again would the obedient old nags come to a sudden halt in answer to the bird’s cry, exasperating the bargee, and delighting the canal bystander. As a rule there is little sense in a parrot’s chatter. Jacob, however, a magnificent thirty-five-year-old macaw that used to guard the entrance to the Melbourne Zoo, gave accurate directions to the public and when he saw visitors attempting to go out through the entrance turnstiles instead of the exit ones, kept calling “Other way out” until his instructions were obeyed. The parrots, parrakeets, cockatoos and lorries hail from all the warmer parts of the world, and are without exception forest dwellers. Their nests are of the “general service” pattern—rough basin-like formations constructed of moss and twigs, sometimes built in the crutch of a branch or tucked away into a hollow tree-trunk. It is common knowledge that a parrot’s “toes” are arranged in pairs, thus equipping their wearer

with the ideal climbing apparatus. The owl, the cuckoo, the toucan, and a number of other birds enjoy a similar "footwear" but to a less highly specialized extent. A parrot once at large in this country can make good, provided there is enough food to hand. Quite a number of parrots and cockatoos have from time to time escaped from their aviaries at the Zoo, and in most cases the fugitives have picked up a living in Regent's Park and withstood the rigours of our winter for many months before giving themselves up. Sometimes the delinquent has been brought back to the Zoo by park keepers, but more usually the runaway has succumbed to home-sickness—or rather Zoo-sickness—and responded to the call of his fellows in the big outdoor aviary. Parrots are undoubtedly amongst the hardiest of tropical birds and are easily acclimatized. From time to time they are bred in the Zoological Society's menagerie. The eggs are usually looked after by both parents, the father bird sitting on them during the day-time and the mother taking night duty. On hatching the young parrots are the most grotesque-looking little creatures, being quite naked and provided with enormous beaks.

A pathetic appeal for a husband was received a few years ago by the curator of birds at the Zoo on behalf of a hundred year-old parrot. The bird, according to its owner, laid a number of eggs every year, only to have them removed, and spent her whole time with imaginary little ones in the corner of her cage, where she deposited bits of all the food given her. The remarkable old bird spent a some-

what belated honeymoon in Regent's Park, but, as was anticipated, with no satisfactory results.

The parrot's restless tongue has won its owner a world-wide reputation. This organ is, however, more than a mere instrument for counterfeiting human speech, for it also plays the part of a hand. Give a parrot a nut, and then watch how cleverly his large club-shaped tongue turns the offering round and round, and working in conjunction with his mandibles, shells it, cuts it into pieces, and finally tosses it down his throat.

The parrot is renowned as a linguist, but he is not without his rivals. Many other birds by a happy combination of brain and plastic vocal organs can emulate the parrot's achievements and some even surpass them. Amongst the members of the crow family there are many "talkers." They are all of high intelligence and have impressed man from quite early times when they were held to be intimate with all kinds of good and evil spirits. They have played an important part in folk lore and heraldry in almost every country in the world. The raven looks his part—that of a knowing and self-seeking rascal. The bird has a genius for selecting snug retreats wherein to raise its brood, and a lonely mountain crag is as likely to appeal to its secretive nature as the ruin of an ancient belfry. Ravens were once not uncommon in London, but to-day their last stronghold in the capital is the Tower, where several live and enjoy the privileges of regimental mascots. Every morning they are fed by the officers in residence, and as they take the proffered scraps

of meat solemnly stalk up and down the Tower Green hoarsely uttering such military phrases as "Wait for it," "Form fours," and "'Shun!"

Another talking crow is the jackdaw. Like the raven he is all in favour of a quiet life, and selects a dizzy cliff ledge with a three hundred foot drop, or a musty church steeple for his residence. In such a situation he brings up his family, one a year, hatching his graceless offspring from four or as many as six greenish blue eggs, dappled with brown. Occasionally he makes a regular nest in some ancient tree and not only upholsters it but protects it with a domed roof made from such materials as moss, leaves, horsehair, etc.

The magpie, another mischievous member of the crow family, is also gifted with the power of reproducing human speech. The term "magpie" has become a synonym for a busy-body or scandal-monger. The reflection thus cast on the bird's character is amply justified, for the magpie will visit nests other than his own and will probe into the family affairs of all kinds of feathered folk. It will steal anything from a hedge-sparrow's egg to a gold watch, exhibiting a most deplorable leaning towards petty larceny which is shared by many other members of the crow family—from the raven to the aesthetic bower bird. Whenever possible it makes a roofed nest—covering its eggs with a "lid" of sticks and branches in order to secure the privacy it loves.

The starling, a close relative of the loquacious raven and the magpie, can be taught to reproduce

many phrases of speech but it chiefly excels as a musical mimic. Specimens have been on show at the Zoo exhibiting very varied repertoires. A tame starling now ornamenting a well-known tavern can accurately reproduce the opening bars of the Volga boat song.

The efforts of the starlings are excelled by the American mocking birds. The starling is capable of imitating the songs and love calls of its hedgerow neighbours but the mocking bird carries the imitative faculty still further. One caged at the Zoo would in the early hours of a summer morning run through a series of selections from the songs of (1) the blackbird, (2) the starling, (3) the thrush, (4) the peacock, (5) the Australian bell-bird, (6) the plover—and as a “grand finale” would burst into a melody peculiarly its own, and equal to the best efforts of the nightingale.

Last but not least amongst the Zoo talkers comes the Indian Mynah. This bird's general colouring is a glossy black, relieved by a ring of brilliantly coloured yellow flesh round the eye, sometimes extending to the base of the bill. The mynah's impersonations are extraordinarily accurate. Whereas a parrot will run through its stock of catchwords in a monotonous tone of voice, the mynah is very quick to pick up the exact intonation of its owner, his way of speech changing with his ownership. Thus a mynah that lived for some years in the North and was transferred to the London gardens, changed its accent from “Coop-tie” to Cockney within a few weeks. The mynah is very

quarrelsome and an inveterate fighter. Its pugilistic propensities are exploited in certain parts of the East, as two cock birds will put up a battle scarcely surpassed by the Indian quail or the old English fighting cock.

CHAPTER XV

SNAKES

SNAKES, in spite of the fact that the majority are quite harmless, are all regarded by the ordinary mortal with an instinctive horror. It is true that they are responsible for an annual human death-rate of approximately 150,000, but this fact alone fails to elucidate the reason for the interesting psychological entertainment which is so often enacted outside the reptile house, where many of the visitors assume an aspect of terror, and give utterance to various exclamations of disgust before being induced to enter the Zoo "chamber of horrors." The reverend gentleman who some years ago wrote to me asking for the loan of a harmless snake in order that he might show his congregation the animal responsible for original sin had obviously himself not inherited an aversion to snakes (provided they were harmless). He had, however, no misgivings as to the effect the snake would have on his flock, and was prepared to make their flesh creep for the good of their souls.

The prevalent dislike of snakes may perhaps be attributed to the creatures' fixed stare, which though credited by the ignorant to hypnotic influence, is really due to the absence of eyelids. That snakes

hypnotize their prey before devouring them is a fallacy, for it has been proved at the Zoo and elsewhere, that with the occasional exception of the higher monkeys, all animals are quite indifferent to their presence.

Comparatively effective results in the fight against mortality by snake-bite have been obtained since the discovery of anti-venine, but unfortunately the poisons of snakes differ from one another, and therefore the use of a serum is ineffective in a district where several kinds of venomous snakes occur. Unnecessarily drastic measures are occasionally adopted by those bitten. An acquaintance of mine, being bitten on the finger by a snake in India, promptly shot off his finger, and then proceeded to shoot the snake. The snake, a harmless one, now reposes, together with the severed finger, in a pickle-jar. A measure recommended in the State of Sao Paulo for the destruction of poisonous snakes is the protection of a large harmless snake called the mussurana, which feeds exclusively on other snakes, showing a partiality for the noxious species such as the fer-de-lance and the rattle-snakes, overpowering and swallowing individuals as large as itself.

In India some years ago a premium was placed on the heads of poisonous snakes. These payments had to be discontinued, for as soon as the measure was adopted the natives took to breeding cobras in captivity, snake farms springing up all over the country. This system was also given a trial in St. Lucia where a reward of 4d. for every fer-de-lance was offered. The inhabitants likewise bred the

reptiles in confinement, and when it is considered that the fer-de-lance brings forth up to sixty young at birth, it is not surprising that these payments had to be abolished. Snake-charmers often extract the fangs of their snakes prior to their performances. There is no doubt, however, that the immunity of the best snake-men is to be attributed to the fact that they have submitted themselves to graduated inoculations of the venom. In many parts of the world the natives profess a belief in the efficacy of snake-stones as a remedy to be applied on the part bitten by a poisonous snake.

These stones, which are calcareous concretions extracted from the bladders of various animals, have no real curative value. How highly they are prized, however, was illustrated not very long ago in India, where an action was tried in which the plaintiff claimed the return, or damages for the loss of one of these stones, and succeeded in recovering ten pounds.

Some snakes have the power of "spitting" their poison, ejecting the venom to a considerable distance, and always aiming at the face of their enemy. The snake with this objectionable habit most developed is the South African Ringhals Cobra, and the new arrivals at the Zoo's reptile house always besmear the glass panes of their cages with the poisonous fluid, in their attempts to blind their visitors. When the doors of the enclosures containing these dangerous reptiles have to be opened for the purpose of introducing food, or cleaning, motor goggles are worn by the keepers for the protection of their eyes.

Snakes may be roughly divided into five groups : (1) Burrowing snakes, of small cylindrical form, which spend most of their lives underground ; (2) Ground snakes, which live above ground, and only occasionally enter water ; (3) Tree-snakes, expert climbers living an arboreal existence ; (4) Fresh-water snakes, which are essentially aquatic, and (5) the Sea snakes which never come to land and are provided with compressed rudder-shaped tails.

Apart from the poisonous forms which seem to have a special attraction for the public, the snakes making the best exhibits in captivity are Anacondas and Pythons, which attain gigantic proportions. The reticulated Python and the Anaconda share the distinction of being the largest of all snakes, each attaining a maximum length of thirty feet. The largest snake at present at the Zoo is a reticulated python measuring twenty-seven feet, an unwieldy and malicious pet presented to the Prince of Wales by the Federated Malay States on the occasion of his visit to the Far East in 1922, and deposited by His Royal Highness in the Regent's Park menagerie.

The moving of such giant snakes is no easy task, and the services of at least fifteen non-panicky men is required when dealing with a specimen of over twenty feet long. In handling these creatures the keepers are disposed at intervals of a foot or two like firemen on a hose. Owing to the crushing powers of the constricting snakes being greatest at the hindermost part of the reptile, a larger number of men are assigned positions on the tail than on the body.

Among the tree snakes are some which are known as "flying snakes" from their habit of parachuting down to the ground from the top of trees, the under-part of the body during this performance being drawn inwards, the creatures becoming concave along their under surface like a piece of bamboo dissected longitudinally. Apart from the cobras, several harmless snakes are able to raise the anterior part of their bodies vertically, and expand their necks, in imitation of their dreaded relatives. A quite innocuous North American species known as the Blow Adder or Hog-nosed snake from its broad upturned snout, has this power highly developed. Another peculiarity of this particular snake lies in the fact that when it finds its aggressive attitude unsuccessful in intimidating its enemy it will turn over on its back and feign death. It is agreed by all who have seen the snake simulating death, that its extraordinary behaviour is not due solely to fright, but constitutes a deliberate trick.

Mr. R. L. Ditmars, of the New York Zoological Park in his *Reptiles of the World* tells an amusing tale of an adventure he had with one of these creatures when on a collecting tour in the Southern States :

"The negroes regarded the species as exceptionally poisonous. They had never lingered by a specimen long enough to discover its habit of 'playing 'possum.' On the way to the savannas, across a cotton-field, a big blow-adder was found crawling along a sun-bathed furrow. The writer's

coloured guides and assistants shouted in terror, urging that this kind of snake be excluded from the collecting bags and instantly killed. They were asked to pause, to form a large circle, and witness the writer's powers in snake hypnotism. The writer explained he could slay the snake by a few waves of the hand, without touching it. Walking up to the snake, a few motions of the hands convinced the creature its hostile airs were of no use, so it soon rolled on its back, becoming apparently lifeless. A murmur of surprise came from the staring circle. The writer insisted the 'dead' snake be passed from one to another to convince his assistants of his powers. With many uneasy motions, nervous laughter and shouting, the snake was handed around by his tail. Then the circle was told to remain perfectly quiet for a minute more, to witness a restoration to life. This provoked a heated argument that the serpent be permitted to remain 'dead,' but the 'hypnotist' was adamantine: he wanted a living specimen for his collection. Placing the snake upon the ground, he made a few eccentric motions, then, removing his hands, kept perfectly quiet. Thinking danger past, the reptile rolled over, and started away. It was caught and put in a bag. The writer's idea had been to promote respect for himself in a wild, and almost lawless region. But the effect was too pronounced. His assistants at once decided that his powers of black art were suspiciously dangerous. They dropped away, one by one, until the ludicrous situation was presented by necessarily changing the

location of collecting in order to leave a bad reputation behind."

Snakes periodically change their skins, the outer layer of the epidermis being cast entire and turned inside out in the process.

Some snakes lay eggs which are produced singly or in clumps, whilst others bring forth active young. As a rule the eggs are deposited in the earth, sand, or among dead leaves, and are hatched by the heat of the sun. In the case of the pythons, however, they are protected by the mother, who by coiling herself round them subjects them to a form of incubation. It was ascertained by the observation of a large specimen that laid eggs at the Zoo and guarded them until they were hatched—a period of nearly three months—that the temperature of the parent's body during this period rose many degrees above the normal.

The food of snakes varies considerably, as does their method of killing their prey. Burrowing snakes feed on worms and small rodents, most ground snakes on various mammals and birds, arboreal snakes on birds and lizards, and aquatic snakes on fish or frogs. A few snakes are cannibals, whilst the small egg-eating snake of South Africa feeds exclusively on eggs. The latter snake is practically toothless, but owing to the presence of tooth-like projections on the vertebral region, and their egg-breaking functions, it may perhaps be said to have its teeth situated on its backbone. The eggs are swallowed whole and reach the gullet unbroken, where they come into contact

with the tooth-like projections of the vertebræ, the object of which is to break the shells, which are later ejected in the form of pellets. The expanding power of the snake's jaws are amazing, and several specimens which lived in the Zoo and had heads no larger than a man's little finger, swallowed bantam's eggs without turning a scale. Mr. F. W. FitzSimmons, director of the Port Elizabeth Museum, has made some interesting experiments to test the intelligence of these snakes. He states in his *Snakes of South Africa* : " You cannot trick him about things which his ancestors for untold generations have learned by experience, and transmitted to him in the form of a remarkably acute sense of smell, which is very necessary for him in his profession of an egg-eater. Being short of fresh pigeons' eggs once, I went to my cabinet and took the clean-blown shells of some doves' eggs. Beating up the contents of a fresh fowl's egg, I syringed it into the empty shells, and carefully pasted tiny bits of tissue paper over the holes. Placing these in the egg-eater's cage, I watched, expecting the snakes to swallow them as they did the other eggs. First one egg-eater advanced, touching each egg gently in turn with the tip of his nose or the point of his forked tongue : he crawled away in disgust. Another and yet another eagerly advanced, repeating the performance and duly retired. Leaving the eggs, I returned in a few hours' time to find them still there. For two whole weeks these eggs remained in the cage untouched, although I refrained from giving the snakes any others. Then procuring some fresh pigeons' eggs, I

put them into the cage. The snakes approached, touched them with their noses or tongue, and instantly began to swallow them. I tried this experiment a second time with the same result. Frequently I noticed that the snakes will eat some of the eggs given them, and reject others. On breaking the latter open I always found them either addled, or with a more or less developed bird inside."

In the boas and pythons and a few other non-poisonous kinds the victim having been seized is surrounded by the coils of the serpent and crushed to death. Some snakes start feeding straight away without making any attempt at first killing their prey, whilst the majority of poisonous species strike at the food before seizing it, and wait for the venom to take effect. As previously mentioned the power of fascination attributed to snakes is non-existent. Many years ago, in the late autumn, I remember introducing a mouse into the compartment of a South African house-snake, which I kept in a cage at home. As soon as the mouse entered the cage it went up to the snake, and insisted on nesting in the centre of its coils, pushing at the reptile until they lay in the required position. The snake and the mouse lived in harmony for some weeks, but as the winter approached, the former decided to dig a burrow in which to hibernate, and this it proceeded to do, the mouse being an interested onlooker. The snake, however, on entering the burrow on its completion was not allowed to enjoy its well-earned rest, being turned out by the mouse, who promptly took possession, the unfortunate serpent being forced to

construct other winter quarters. On the completion of the second burrow the mouse once more ejected the rightful tenant, and settled down in it, the snake returning to the one he had been forced to evacuate. With the advent of spring the long-suffering reptile's mind turned to thoughts of food—and possibly revenge, with the result that it made a meal off its companion with which it had cohabited for nearly six months.

That snakes have little sense of taste was demonstrated some years ago at the Zoo, where a python swallowed a blanket which had been placed in its cage. Another python kept by an acquaintance of mine swallowed a large bamboo pole. On this occasion the pole was being used to push forward a dead rat towards the hungry reptile's head. The snake, seeing something move, seized hold of the rod which it proceeded to swallow, not finding out its mistake until it had got over two feet down its throat, when it disgorged the unsatisfying meal. The process of swallowing is a more or less mechanical one, for snakes, being provided with recurved teeth, once they have seized hold of their prey find it extremely difficult to let go, and have to go on swallowing. It occurs therefore that when a number of serpents are kept together in the same cage two will sometimes seize hold of their prey at opposite ends with the result that when their snouts meet in the middle of the body of one of the animals served up for their dinner, the snake with the largest gape proceeds to swallow its companion. Such incidents occur from time to time at the Zoo. Not long ago two large

North American king snakes measuring nearly six feet in length seized hold of a rat at opposite ends. A tragedy was only just averted, for when the keeper's attention was first drawn to the occurrence only three or four inches of the smaller snake's tail was protruding from the mouth of the larger specimen, who was eventually forced to disgorge his unfortunate cagemate. It would be imagined that the serpent that had been almost completely swallowed would have died or at least suffered from shock. Not so, however, for the victim was so little put out by the experience it had gone through, that it actually continued its meal and put away several rats and mice within a few minutes of having been disgorged. A similar incident recently occurred in one of the python's cages, when two large African specimens seized hold of a rabbit at opposite ends. The termination of the incident was not so happy a one as in the case of that of the king snakes, for the larger python refused to let go its hold of its slightly smaller companion, which it proceeded to devour.

King snakes, which are black in colour, marked with yellow or white bands, feed not only on small mammals and birds, but also on other snakes. It is in fact a decidedly useful creature as it wages war against rattlesnakes, moccasins, and other deadly North American snakes, to the poison of which it is said to be entirely immune.

The enormous size of the prey which some snakes are able to swallow is quite remarkable. Anacondas and pythons have been observed to swallow fair-sized antelopes with their horns, such feats being rendered

possible by the great elasticity of the ligaments by which the jaws are attached and the mobility of the ribs.

In captivity snakes are somewhat capricious in the choice of their food. A reticulated python, for instance, which lived many years ago in the Jardin des Plantes, Paris, had been starving for some months, although offered the ordinary bill of fare that is usually provided for pythons—ducks, fowls, rabbits, etc. Then a goose which formed part of the collection broke one of its legs, and as it had to be destroyed it was put into the cage of the fasting snake. The python immediately seized hold of it, and made its first meal since its arrival in Paris. The curator thought that naturally henceforth it would go on feeding. But not so. Fowls and ducks were once more refused. Some months later, as an experiment, another goose was introduced into its cage, and was again immediately taken. It was eventually found that this snake would only eat geese, refusing all other food.

Snakes are capable of going without food for very long periods. Thus an Indian python received at the Zoo in July, 1920, and at the present time in the best of health, took its first meal in Regent's Park in February, 1922. The record is however, held by a boa kept in Paris, which fasted for four years and a month.

The distinction of being at the same time the deadliest and most aggressive of all the snakes is shared by the King Cobra or Hamadryad of India, which may attain a length of fourteen feet, and the

somewhat smaller and more slender Mamba of tropical and South Africa. The bite of the king cobra produces death in man in anything from one to six hours. An eye-witness of an elephant bitten on the trunk by this snake has recorded the fact that the victim died in less than three hours. The king cobra feeds exclusively on snakes, and a large specimen which has been an inmate of the Zoo reptile house for some years devours three or four common grass snakes at a single meal. The first specimen arrived at the Zoo in 1875. It was inadvertently placed in a cage with a number of common cobras, and being very hungry after its long journey it devoured a number of them before its identity was discovered. This meal cost the Zoological Society £25, some of the snakes eaten being the property of a dealer who had deposited them in the gardens.

The Mamba varies in colour from grass green to black. Green specimens are arboreal, living in creeper-covered bush or the boughs of trees, whilst brown or black specimens seldom venture from the ground, frequenting the neighbourhood of old farm buildings and other localities where rats and mice are abundant. Unlike the majority of snakes the mamba when surprised does not rush off in an opposite direction, but instantly pursues the intruder venturing in the neighbourhood of its haunt. Whilst travelling at full speed it can strike right and left, and it is therefore not surprising that it is the most dreaded of all snakes in Africa. The green variety often chooses to lie entwined in the branches of trees overhanging the paths, with the result that natives

are often bitten on the hand or shoulder whilst passing under the branch of a tree in which one of these snakes is hidden. A well-known South African naturalist has stated that as a general rule the more we learn about snakes and their ways the less fear we have of them, but the more one learns of the mamba and its ways the greater grows the fear of that deadly and aggressive creature.

No cage in the Zoo's reptile house attracts more attention than that containing the Rattlesnakes of which nearly a score of species are known, and all are distinguished by their rattle. Many other serpents have equally large poison fangs, but the "rattler's" caudal appendage marks him as a snake apart and has earned for him a world-wide reputation. All kinds of extravagant theories attach to the rattle, which consists of a number of caps of horny skin filled with air loosely interlocked to form a string of beads which may range in length from one to fifteen. The Indians maintain that a segment is added to the rattle each time the snake kills a man—doubtless another version of the "scalp fetish." More enlightened but still misinformed persons have broadcasted a theory that the length of the rattle is an index to the snake's age. A string of more than ten segments certainly suggests that the owner is fairly mature, but considering that portions of the rattle are continually being knocked off or otherwise detached it will be seen that their evidence is at best unreliable. The rattle in the newly-born snake is represented merely by a small horny button, the subsequent segments being added each time the snake

changes its "skin." The rattle, when in action, produces a sound very suggestive of running water, and the theory has been propounded that it is intended to decoy animals in search of drink. It is more plausible to suppose that it is intended as a warning. Despite its deadly properties the rattle-snake accounts for very few human lives, as it seldom strikes unless attacked and usually keeps in hiding. As recounted in the chapter "After Dark" it is said to have a penchant for sharing peaceably its underground retreats with the burrowing owl and prairie marmots. The snake does undoubtedly consort with the owls and the marmots, especially when the house-holders have families. In fact the stories of such partnerships must, like certain of the "rattle" theories, be relegated to the archives of un-natural history.

Some of the harmless snakes at the Zoo have now and again escaped, but their liberty has always been short-lived. A small Trinidad snake which was received from Covent Garden Market where it was found coiled round a bunch of bananas disappeared from its cage the day after its arrival at the reptile house. About a month later the attention of the curator was attracted to the enclosure inhabited by the cannibal horned viper, which was devouring another snake. Close inspection revealed the unfortunate victim to be none other than the missing Trinidad specimen. How it came to find its way into the compartment of the horned viper remains a mystery to this day. On another occasion a seven-foot-long python escaped, owing to a defect in the

mechanism of its cage, and was not found until after it had been at liberty for over three months, when it was observed by a visitor coiled round an ornamental pinnacle which surmounts the roof of the reptile house. The visitor was at first under the impression that the snake was an architectural decoration. He changed his mind, however, on seeing the reptile uncoil and descend from its resting-place, and hastened to inform an at first sceptical keeper, whose experience of every kind and condition of Zoo visitor covered a period of over thirty years.

CHAPTER XVI

LIZARDS

THE lizards, of which a great variety are exhibited at the Zoo, are typical reptiles inhabiting all countries registering a tolerable amount of sunshine. A few are found wild on Hampstead Heath whilst some exist even so far north as Scotland, but the race attains its maximum development in the tropics—in jungle swamps as well as waterless deserts. Lizards exhibit an amazing diversity of form and differ much in their habits. Some move like “greased lightning,” others would figure among the “also ran” if entered in a tortoise race. Some flame with colour, others are as drab as the rocks amidst which they live. Only one species is harmful to man.

Living lizards must not be regarded as the degenerate descendants of the huge eighty-foot long monsters that once walked the earth. The ancestors of the modern lizards were contemporaries of the giants, but only distantly related to them and in size and shape were much like the forms living to-day. The majority of lizards prefer to live “on the flat,” but a number are arboreal, and a few have taken to burrowing, and serve as an awful warning on the evils of over-specialization. Thousands of

centuries of tunnelling have literally rubbed away their limbs, and reduced the reptiles to an almost worm-like form. The Amphisbaena of Spain and Portugal and South America is a good example. Apart from being limbless, it is afflicted with blindness, the eyes being rudimentary and covered with skin. It is able to progress both backwards and forwards and moves not as in all other limbless reptiles by lateral movements, but by vertical undulations. As a result of the tail of the creature being short and stumpy and resembling the head in shape, certain superstitious natives of Brazil believe that it possesses a head at either end and assert not only that each feeds in turn but that while the one end sleeps the other watches.

The majority of lizards lay soft-shelled eggs which are deposited in the ground and are hatched by the heat of the sun. A few, however, bring forth their young alive, the stump-tailed skink of Australia, which is covered with enormous rough scales suggestive of the cone of a fir tree, producing a single young at birth, the newly-born lizard being remarkable for its size—half that of the parent.

One of the most startling members of the tribe is the Frilled Lizard of Australia. It is about three feet long and differs from all other kinds of lizards in its possession of an immense frill, which surrounds the head and neck—an umbrella-like formation of skin supported by stout rods of cartilage. When at rest the frill falls over the neck and shoulders like a cape. On the wearer becoming annoyed it expands and surrounds the head like an Elizabethan ruff, the

expansion synchronizing with the opening of the mouth. The effect is terrific, but although the creature has sharp teeth it never attempts to bite, and its strange performance is just a piece of "bluff," and merely intended to frighten the intruder. In the event of this exhibition of "frightfulness" failing in its purpose, the lizard takes to flight, and in the queerest manner. Folding the frill, it rises on its hind legs, and with the body bent slightly forwards, makes off at a gait reminiscent of that of Mr. Charles Chaplin. The frilled lizard lives chiefly upon insects which it hunts both on the ground and on trees. The few specimens that have lived at the Zoo became so tame that they lost their major attractions as exhibits, since after only a few weeks of captivity they refused to display or perform their entertaining walking act.

Apart from the frilled lizard, Lesueur's Australian Water-Lizard is the only member of the tribe which is able to support itself for short distances on its hind limbs.

A more common Australian lizard and one closely related to the frilled lizard is known by the name of Bearded Lizard from the fact that the long erectile bristles on its throat present a likeness to a beard. Many living lizards are heavily armoured. Thus the South African Zonure is remarkable for its enormous spiny scales which cover the entire head and body and project like those of a pine-apple.

The American Horned Lizards, or Horned Toads as they are often erroneously called, fairly bristle with spines from head to foot and recall the armoured

dinosaurs of old, save for their diminutive size. They abound on the burning wastes of the southern United States and Mexico, where they hunt for the small insects upon which they live. Speed is not their strong point, but their armature ensures them immunity against most aggressors. A second means of defence is the habit they possess of squirting fine jets of blood from the corners of the eyes to a distance of four or five feet, temporarily interfering with the vision of the pursuing enemy. When found on sand these grotesque-looking creatures are uniform grey or brown in colour, but specimens emanating from forest districts are greenish-grey with markings which exactly match the lichen-covered rocks they frequent. In the neighbourhood of the black lava belt near San Francisco the lizards are black with yellow markings, the gloss of the black lava being faithfully reproduced.

In the flat-bodied Mastigures of the arid wastes of South-west Asia and North Africa only the tail is provided with spines. They are slow moving lizards and easily overtaken, but put up a vigorous defence when handled, augmenting their biting powers by lashing the spike-encrusted tail from side to side like a flail. If kept sufficiently warm the mastigure can be tolerably spry. It needs, however, to be provided with a temperature of at least 90 degrees F. to exhibit much vivacity. Mastigures are omnivorous feeders, but total abstainers from any form of drink. This refusal to participate in liquid refreshment was once a source of much perplexity to the authorities. Quite by chance it was discovered that the lizards took in

water through their skins, and now the Zoo mastigures are regularly sprayed.

There is no more handsome inmate of the reptile house than the large long-tailed Iguana of the forests of tropical America. This powerful arboreal creature which attains a length of six feet has a somewhat compress body, surmounted by a crest composed of large soft leathery spines, extending from the neck to the tail. It is bright green in colour, with broad black bands on the sides, and black rings on the tail.

At the Zoo these lizards prior to the installation in their enclosure of special electric light generating the health-giving violet rays, would seldom feed, and very few ever survived a winter in Regent's Park. Since, however, it has been made possible to supply them with artificial sunshine on gloomy winter days a most striking change has come over them. They have lost all their former apathy, are now full of the *joie de vivre*, and throughout the year take an intelligent interest in their menu which is composed of such delicacies as grapes, bananas, and lettuces. The flesh of the iguana is said to be excellent eating, resembling that of young fowl. The reptile is consequently sold in the local markets and is much hunted for, being often captured by means of dogs, specially trained for the purpose.

The "Glass Snake" is a lizard inhabiting South-eastern Europe in which the limbs are quite rudimentary. It grows to four feet in length, is intensely hard to the touch, and shines like burnished copper. Like certain other lizards it readily parts with its tail if seized by that organ, and whilst its tormentor con-

templates the writhing caudal appendage the "glass snake" makes for safe cover, there to grow a new tail at his leisure. Its nearest English relative is the harmless Slow Worm, which is so often mistaken for a venomous snake and is still regarded by the ignorant with superstitious dread.

The only poisonous lizards known are the two species of Beaded Lizards from Arizona, Mexico, and Central America. The commonest form and one always on exhibit at the Zoo, where specimens have lived for twenty years, is known by its native name of Gila Monster. It is a heavily built creature with a massive head, closely set with beady scales coloured bright salmon-pink with a black "futurist" pattern, like oriental beadwork. The jaws of the gila monster are provided with a large number of grooved fangs which are connected with a pair of large poison glands, and by means of these it can inject so active a venom as to produce death in man. A serious accident took place not long ago at the Pasteur Institute in Paris, where one of these lizards, which was being experimented on, retaliated, and bit the experimentator. The victim only just escaped with his life and was seriously ill for many months. The gila monsters in the Zoo are very tame and have never been known to manifest any desire to attack their keepers. Like another desert dweller, the camel, this lizard carries an emergency ration of fat. Instead of carrying it in a hump it stores its reserve fat in its tail, and in lean times can subsist upon this "stand by" for many weeks.

The Monitors are the largest living lizards. All are

vigorous, rapacious reptiles, handsomely marked, and characterized by their long necks and restless tongues, which are ceaselessly employed to explore the surroundings. They are confined to the tropics of the Old World, the largest Zoo specimen measuring eight feet in length. A monitor recently discovered in Comodo, a small island in the Malay Archipelago, is reported to attain a length of twenty-three feet. These lizards are expert swimmers, and hunt both afloat and ashore all such creatures as they are capable of overpowering. Often the work of slaughter is aided by the claws, which are as large as those of a cat. They are also very fond of eggs, and a specimen which lived for many years in the reptile house would devour as many as eight hens' eggs at a single meal. The larger species of monitors can deal blows with their tails as severe as the castigations inflicted by a hippo-hide whip.

Most of the typical lizards of Europe, such as the Eyed Lizard, the Wall Lizard, the Green Lizard and the Common Viviparous Lizard of this country, can climb with agility. In most places in Central and Southern Europe the wall lizard is one of the commonest features of the landscape, and in certain towns it may be seen disporting itself on the streets and "perching" on the roofs of houses. It is to Marseilles for instance what the sparrow is to London, and the visitor to the local zoo will be amazed to see it sunning itself on the backs of recumbent lions, darting in and out of the bear dens, and mountain-eering on the horns of the buffaloes.

No visitor to the reptile house leaves without

inspecting the Chameleons, which differ from ordinary lizards in having prehensile tails, in their feet being formed like those of parrots, the fingers and toes being united in two opposable bundles to form grasping organs, in their possession of projectile tongues, and in their eyes being capable of moving in every direction. The eyeball is enormous and entirely enclosed in skin, save for a mere pin-hole opening in the centre, and the two eyes roll independently in their deep sockets with ludicrous results, one gazing perhaps at the ground, whilst its fellow may be surveying rearward objects, or contemplating the sky. Chameleons belong to an Old World group, inhabiting tropical and semi-tropical countries. Although a few are distinguished by supporting horns on the head, the majority are fairly uniform in general build, and range in size from a few inches to a foot or more in length. They are all arboreal, climbing with much deliberation. They stalk their insect prey with exaggerated stealth, until within a distance about equal to their own length. Then suddenly, by the action of certain special muscles, the sticky club-shaped tongue is shot forth with lightning speed ; the insect adheres to its tip and it is withdrawn into the mouth. It is difficult to understand how the chameleon can have won such a world-wide fame for changing colour. It certainly can assume the most varied hues, often with surprising suddenness and effect, but frequently at variance instead of in harmony with its surroundings. Many other lizards are far more adept at quick changes, whilst many marine fishes and the octopus leave any

lizard—let alone the chameleon—far behind in the art of becoming one with a constantly changing background.

A lizard-like creature which has been exhibited in the reptile house for many years but which strictly speaking is not a lizard at all, is the Tuatera of New Zealand, a stoutly built creature, which in size and general shape recalls the iguana. It can almost be called a living fossil as it is the sole survivor of a very ancient group of reptiles, and the ancestor of the modern tortoises and crocodiles. A feature of the tuatera is its possession of a vestigial structure situated at the top of the head, believed to represent a once functional eye.

CHAPTER XVII

FROGS AND TOADS

ALTHOUGH frogs and toads are not generally regarded with the same hostility as the reptiles they cannot be said to be among the most popular inhabitants of the Zoo, and as a rule they merely arouse feelings of disgust amongst those visitors who are ignorant of their cleanly and useful ways of life. Some make entertaining pets, the intellectual powers of a few like the Common Toad being comparatively high, whilst special interest is to be found in a study of the various very ingenious ways and means that they adopt in order to raise their families.

Amongst the innumerable kinds of frogs and toads exhibited in the lobby of the reptile house the acrobatic tree-frogs owing to their bright colours and graceful ways alone are popular, finding favour in the sight of those visitors who are repelled by their less conspicuous and less active relations. Specially attractive is the little bright-green European Tree Frog which has dilated finger tips and is to be observed attached by these to the glass panes of its cage. The voice of the creature is so extraordinarily loud at times that its introduction in large numbers into the Isle of Wight resulted some years ago in the

property in the neighbourhood inhabited by the tree-frogs depreciating in value to quite a considerable extent. The loud chirping sounds are produced by the males only, their vocal sacs forming bladder-like pouches, which when the animals are giving vent to their feelings are blown out to a size equal to that of the frogs' bodies. The European tree-frog has a reputation for being a weather prophet and on the Continent is often kept in glass jars provided with a ladder, which it is expected to ascend when forecasting a fine spell and descend on the approach of rain. At the Zoo the frogs, if they ever had any capacity to foretell the weather, appear to lose it.

Other tree-frog vocalists at the Zoo are the beautiful Golden Tree-frog of Australia whose song resembles the mallet and chisel sounds of a number of masons at work, and the South American frog known as the Smith, from its voice which sounds like the regular beating of metal plates. The female of the latter frog is an accomplished architect and builder, and constructs circular nurseries surrounded by walls of mud, for the reception of its eggs, thus protecting them from fish, water beetles, and other enemies.

Some years ago a number of little tree-frogs, natives of the West Indies, and remarkable in that the whole of their development is undergone within the egg, were presented to the Zoological Society by the Royal Gardens at Kew, where they had been introduced unintentionally into one of the hot-houses.

A toad carrying its eggs coiled round its hind-limbs is a sight that in the spring has often attracted the

attention of visitors to the reptile house. This toad, a native of Europe, is known by the name of the Midwife Toad from the fact that its eggs, which are deposited on land instead of in the water, as in the case of the majority of frogs and toads, are taken care of by the father who twines them round his legs. He carries them about with him for about a month, when they are ready to hatch he makes for the nearest pond where he relieves himself of his burden.

Of all the frog and toad vocalists that have inhabited the Zoo, the little Fire-bellied Toad of Uruguay is the most accomplished, its call resembling that of the British Greenfinch. Being of a uniform black colour above, the casual observer might be forgiven for mistaking it for a beetle, this superficial resemblance being enhanced when the toad is on the move, for its mode of progression is by means of short runs, and not by hops. Viewed from above it is inconspicuous ; the hinder parts of its under surface, and legs, however, are of a bright scarlet, so that when the little frog is on its back it appears to be wearing a pair of red bathing-drawers. This brilliant coloration serves as a protection, for when surprised it will immediately turn over, remaining perfectly motionless until the supposed danger has passed. The very few conspicuously-coloured animals that rely solely on their appearance as a means of intimidating their enemies are nearly all poisonous. This fire-bellied toad is no exception to the rule, and this exhibition is intended as a warning, as it secretes a very active poison when seized hold of. The European fire-bellied toad also secretes a fairly active

poison, and will likewise when surprised feign death, and by exposing the hinder part of its body and limbs display the brilliant red or yellow markings of its under-parts.

The Brazilian Scarlet Frog, a frequent inhabitant of the Regent's Park reptile house, is yet another frog which exhibits what has been called "warning colours." This bright scarlet creature produces a poisonous secretion which acts on the heart and central nervous system. The venom is so potent that it is actually used by certain natives for poisoning the tips of their arrows with which they kill such comparatively large animals as deer and monkeys. The secretion is also used for the purpose of dyeing the feathers of Amazon parrots. The green feathers are plucked out and the skin is then rubbed with a living frog. As a consequence the new feathers when they appear are yellow, instead of green, which enhances the value of the bird in the eyes of the natives.

The striking Ornamented Ceratophrys or Barking Toad, a large South American toad marked with green, yellow and black blotches and sporting raised triangular-shaped eyelids is the most vocal member of the Zoo's frog and toad population. It uses its voice, however, not to display pleasure, but anger, the piercing sounds that it produces resembling the barks of a discontented lap-dog. During the display of temper the lungs are greatly inflated, with the result that its multi-coloured body which is then raised from the ground becomes swollen like a balloon. The creature is then extremely grotesque

in its appearance, recalling to one's mind some fantastic toy animal, rather than a living creature. The object of the toad's jazz pattern is camouflage, for when it buries itself half in the ground as is its habit, it becomes almost invisible. At the Zoo when placed in a cage in which green vegetation is lacking it has been observed to throw earth over its back with its hind feet. Thus lying half-buried, and perfectly motionless, it waits for the small frogs upon which it lives to pass over it, when the unsuspecting victims are snapped up with lightning rapidity. The North American Bull Frog is likewise good at making itself heard, and when the occasion arises, produces a fair imitation of a bellowing bull. The smallest frog in the world is one attaining a maximum length of half an inch. It is known by the name of Darwin's Frog from the fact that it was discovered by Darwin on his voyage in the *Beagle*, and is remarkable in having a triangular-shaped snout ending in a long fleshy appendage. One of the most remarkable modes of protecting its offspring is adopted by the male of this creature, for as soon as the eggs are laid they are swallowed by the father who retains them in his throat until the young are ready to emerge as perfectly formed frogs.

The largest frog in the world is Goliath's Frog of West Africa, which may measure a foot in length. Its mouth is so enormous that it experiences no difficulty, if so disposed, in swallowing a young chicken or a full-grown rat. Some years ago an attempt was made to procure a specimen of this giant frog for our gardens. The frog was actually

captured and shipped, but unfortunately escaped on the journey. The specimen in question was put into an empty ten gallon spirit drum with water at the bottom. It however evidently objected to the accommodation provided, for on the second day out at sea it succeeded by means of a series of huge leaps in raising the heavy lid of the receptacle—a feat requiring enormous strength—and in committing suicide by jumping overboard.

One of the most remarkable frogs ever exhibited at the Zoo is a Brazilian form called the Paradoxical Frog. Although no larger than our common frog its tadpole grows to a record size, far exceeding the adult both in length and bulk. In consequence of its enormous girth the tadpole was described by the old writers as an animal which began life as a frog but which eventually turned into a fish.

CHAPTER XVIII

THE INSECT HOUSE

THE inmates of the insect house which include not only insects but a variety of other invertebrates outnumber those of any other house in the gardens. Almost every modern device from the submarine to wireless has been anticipated by these backbone-less creatures, some of which are of economic importance as destroyers and protectors of life and property, and a few, such as the silk moths, are of commercial value ; but owing to their complex mechanism controlled by the minimum of reasoning power, it must be admitted that they fail to enlist quite the same sympathies and human interest as do the higher animals. The difficulties attending a public exhibit of invertebrates are endless. Apart from such items as the careful regulation of lighting, temperature, etc., the majority offer difficulties of their own making. A large number are predacious to a degree, and it is in vain for a curator to explain that the conduct of his charges is entirely in accord with the laws of nature should a visitor complain of, say, a lady spider who has dined off her consort immediately after the marriage ceremony. A certain number of insects and other invertebrates make very charming exhibits. Many of the butterflies are kept

during the summer months in a huge outdoor cage like a chicken-run, but with a finer mesh, and there is no prettier sight in the gardens than this flower-decked cage full of peacocks, fritillaries, camberwell beauties, swallowtails, etc.

The visitor privileged to enter such a run is requested to shake his hat before leaving. Quite recently a distinguished entomologist was observed to step out of this fairy-like enclosure adorned with a prosaic bowler hat converted into a crown of glory. Quite a hundred red admirals and tortoiseshells had settled upon it during his short sojourn in butterfly-land.

Next to the butterflies the hawk moths are possibly most attractive, especially when being fed by hand with spoonfuls of syrup. The moths in a fluttering shower settle on the spoon's brim and, extending their long ribbon-like tongues, sip the draught with obvious enjoyment. The largest of all moths, the Atlas Moths, which may measure nearly a foot across the wings, is always on view in the insect house during the summer months. On one occasion a display of these creatures greatly impressed a bank holiday visitor, who was overheard to express gratitude for living in a country where the possibility of moths of such enormous size getting at one's clothing was precluded.

Captive butterflies and moths demand infinite care, as almost every species requires some special food plant. One kind must have its cage syringed with diluted syrup; another requires sugar mixed with mud; a third will die unless its surroundings are

daily sprayed with salt water in order that it may be deluded into thinking that it is living at the seaside. Visitors may observe that some of the small trees in the cages are enclosed in sheets of muslin. The object is to keep the larvæ feeding upon them within bounds. Many of the Zoo's butterflies and moths arrive in the form of cocoons, which are kept at exactly the right degree of temperature and moisture to ensure the inhabitants emerging when required by the authorities. A certain cocoon often on view in the insect house is the size of a coco-nut and contains many scores of chrysalids. It is the work of "sociable" caterpillars who elect to go to bed *en masse*, encasing themselves in a shell or rind of dead leaves which shelters the whole community.

Those curious allies of the cockroaches known as Stick Insects, and Leaf Insects which resemble twigs and leaves are amongst the most interesting of all the invertebrate inhabitants of the Zoo. So striking is the resemblance of the leaf insects to the leaves of the plant upon which they are placed that visitors are often to be observed searching for them in vain. In fact the cage would sometimes be regarded as empty were it not for the label drawing attention to their presence. The wings of these creatures cover the greater part of their bodies and resemble leaves not only in shade and shape but in the fact that their veins are so disposed as to form an exact reproduction of the prominent ribs present on the leaves of many plants. The colour of the insect, which is usually bright green, is due not to pigment, as in most green

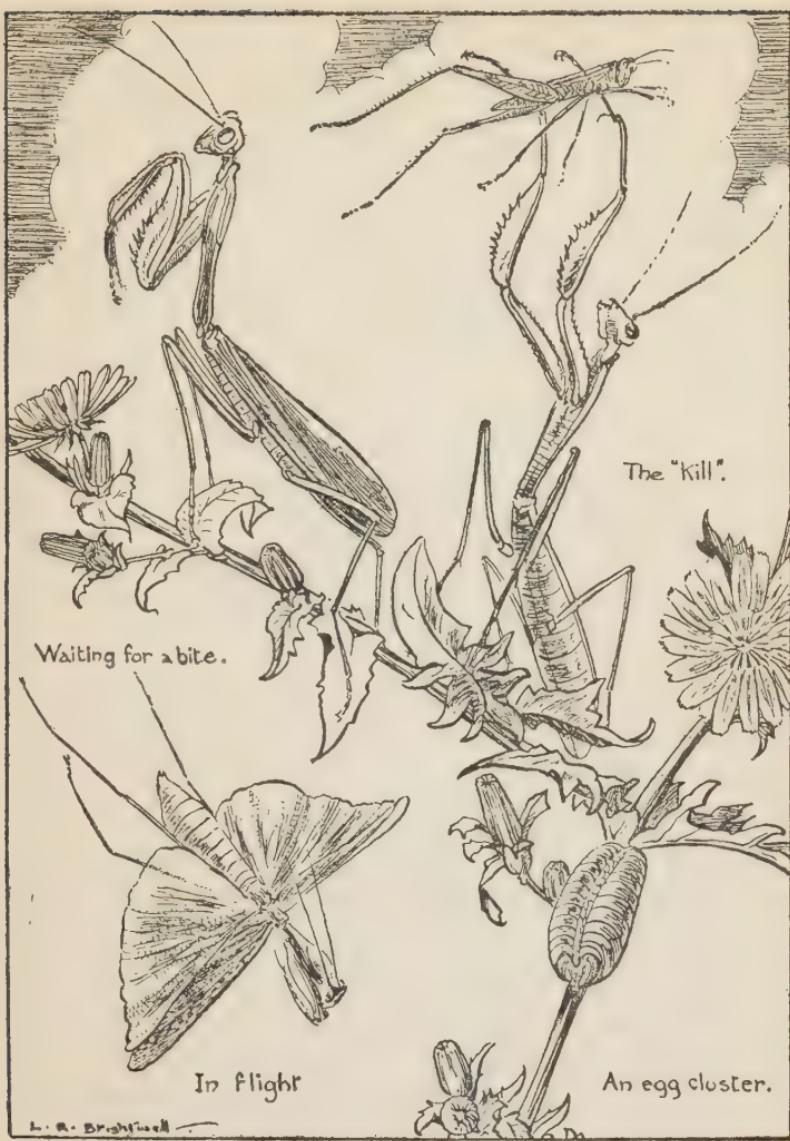
animals, but to a substance almost identical in its composition with the colouring matter in plants. Before death most specimens pass through the different hues of a decaying leaf. Leaf insects are vegetarians, but appear themselves to be from time to time taken in by their resemblance to leaves, for when short of food they begin nibbling pieces out of one another. The eggs which are shed on the ground —the mother making no provision for their safety, are remarkable in being so like the seeds of certain plants that experienced botanists have often been deceived by the similarity.

Another interesting inmate of the insect house is the Praying Mantis, so named from the posture it assumes when resting on a shrub, awaiting the approach of the small insects upon which it lives. The creature when on the look-out for food rests on its two hindermost pairs of legs, with the front pair raised and clasped together as if it were engaged in an act of devotion. When the unfortunate victim alights within its reach the mantis slowly relinquishes its characteristic attitude and strikes at its prey with lightning rapidity. Having completed its meal, this insect hypocrite once more assumes an attitude of prayer. No other insect has among the superstitious such a reputation for saintliness, and in parts of Southern Europe the mantis is still regarded with reverence, it being deemed by the peasants very unlucky, if not a crime, to injure or kill one. Various species of mantis are found all over the warmer parts of the world. The Arabian species is stated by the natives to pray with its face towards Mecca. The

Hottentots actually worship the creature, and should a mantis happen to alight on one of their number, the individual immediately becomes a saint. The creature is very quarrelsome and will attack its own kind on the slightest provocation, the conqueror devouring his unfortunate antagonist. To the Chinese these pugnacious habits are well known and the insects are made to fight one another in public. The fights are held under recognized rules before large crowds and quite large sums are wagered on their results.

Another crafty Zoo boarder, who is usually accommodated in a neighbouring compartment to the mantis, is known by the name of Ant-lion. Ant-lions are the larvæ of a large fly, and dig holes in the sand, at the bottom of which they lie hidden from sight. When an ant falls into one of these pits it is immediately dragged under by the ant-lion and devoured. On occasions these unpleasant creatures throw up showers of sand to hasten the descent of their unwary victims.

Among the ants the most interesting are the leaf cutting species, which are remarkable in that they feed on a fungus, and in order to have a constant supply of such food cut from various plants small pieces of leaf which they carry down to one of their underground chambers. There the pieces are spread out to form a bed on which the fungus soon develops. These ants in their enclosure at the Zoo may always be observed hard at work, carrying pieces of leaf to use for the cultivation of the fungus upon which they thrive.



THE "PRAYING MANTIS"

The Zoological Society is constantly receiving interesting spiders.

The South American Trap-door Spider whose abode serves the dual purpose of excluding enemies and keeping out the rain is a strange form. The architecture of its home consists of a long tube constructed of earth and lined with silk. The mouth of the tube is closed at each end by a door composed of earth and dead leaves, which flaps loosely over the tube and is connected to it by a hinge like attachment. One of the doors is seldom used, and serves only as an emergency exit. On an intruder attempting to open the main entrance the spider will attempt to keep it firmly closed by holding on to it with its claws. In the rare event of an entrance being forced, however, an escape is effected through the back door. The eggs of the trap-door spider are laid in the tube, and the young when only a few weeks old leave the parental roof and go out into the world to build homes of their own.

The largest spider exhibited is the so-called Bird-Eating Spider of the West Indies, which may measure ten inches in circumference. In its native haunts the creature hides in a hollow tree by day, issuing forth at night in search of its food which consists mainly of insects. It is only occasionally that it helps itself to young birds. It is a highly poisonous creature, its fang-like mandibles being connected with a pair of large poison glands, whilst the long bristles which cover the body and limbs irritate the skin like a nettle.

Another poisonous inhabitant of the insect house

is the foot-long Giant Centipede of Trinidad. It is a repulsive-looking thing and its bite is a dangerous one for through a pair of enormous tubular fangs it pours a highly venomous fluid into the wound. Each segment of the centipede's body is provided with a pair of claws which are likewise poisonous and leave an inflammatory trail over the body of the victim. The popular name of centipede is somewhat of a misnomer, for it is a curious fact that these creatures are always provided with odd numbers of paired legs, and there are types, with forty-nine pairs and fifty-one pairs, but none with fifty pairs. Centipedes are usually regarded as unpleasant objects without any redeeming features. There exist, however, natives in South America, who extract large specimens from their burrows and having torn off their heads with the poison fangs, and the legs, proceed to devour the remainder amid obvious manifestations of pleasure.

A number of molluscs are represented in the fresh-water tanks, including some enormous pond snails known by the name of Apple Snails, which hail from all the warmer countries. They are heavy, sluggish creatures, much addicted to a sedate perambulation of the muddy floor of their aquarium. They are provided with long siphon pipes for the inhalation of air, and in the spring crawl above high-water mark and lay their eggs upon the stems of reeds and rushes. The eggs, which resemble huge masses of caviare when first laid, are of a beautiful lilac tinge. In less than a month they turn brown, crack, open, and the infant snails, emerging, glide down the plant

stems and leave the light and fresh air for a life of retirement in the mud.

A centre of attraction in the insect house is the case containing the Giant Land Crabs of West Africa. Under natural conditions these crustaceans, which are remarkable for their large protruding eyes set on long stalks, live some miles from the coast, spending most of the day under stones. They only visit the sea-shore during the breeding season, when on a certain spring day the whole of the local land crab population emigrates to the sea in which the eggs are deposited. Issuing forth from their innumerable retreats they congregate together in their millions and proceed to the coast, the males leading the way. The procession may be over a mile long and forty yards wide, and the animals travel in an absolutely straight line for their destination. No obstacle, however great, will turn them from their course, and on their way even houses are invaded. The noise of this nuptial march has been compared to the rattling produced by an army of cuirassiers. The eggs having been deposited in the sand just below high-water mark, the crabs' homeward journey to their inland retreats commences. On their return the exhausted creatures shed their shells, and while in such a state are regarded by the natives as delicacies.

At the Zoo when these crabs are observed carrying their eggs they are transferred to the aquarium, an easy journey compared with the hazardous and wearisome voyage to the seaside which they are compelled to undergo in their native land.

CHAPTER XIX

DE MORTUIS

IN the foregoing pages we have reviewed a variety of animals filled with the joy of life, pursuing their life-cycles in captivity with as much zest as they, or their forebears, might have done in their native wilds. But there must come a time when the wheels begin to revolve slowly and, whether man or beast, eventually stop altogether. What then? From time to time one hears of some public-spirited person bequeathing his or her body to the medical profession for dissection—and the ultimate advancement of science. The Zoo's inhabitants, denied any such control over their remains, are one and all dedicated to the sum total of zoological or medical knowledge. The dead are taken to the prosectorium and there subjected to a searching examination by anatomists and pathologists. Every scrap of a dead animal is more or less "bespoke." After the primary analysis and the cause of death has been ascertained, the body is disposed—the skin to a taxidermist or furrier, the skeleton to an osteologist, and the internal organs to a score of experts in hospitals, museums and private and public laboratories.

An enormous amount of time and energy is expended upon the study of the Zoo's dead.

The value of the work is not as fully appreciated as it should be by the general public, who fail to realize the fact that the more we know of the "lower animals" the better we understand our fellow men, and that every post-mortem conducted in Regent's Park is a fresh nail driven into the coffin of the arch-ogre Disease. There is a lighter side to everything, even to the last great adventure. Some time back an animal painter took away with him from the prosectorium the carcass of a huge hamadryad baboon. He acquired the remains at about the same time that a notorious and particularly revolting crime had taken place. Running across the bridge leading to Waterloo Station, he suddenly found his progress checked and himself surrounded by a number of plain-clothes policemen. A grubby but human hand was protruding from his suit case. The artist cleared his character by disclosing the baboon, but missed his last train home.

